THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 52 OCTOBER, 1933 No. 2

THE SOILS OF RENOVATED ABACÁ (MUSA TEXTILIS) FIELDS IN DAVAO AND THE REPORTED INFERIOR GROWTH OF THIS PLANT THEREIN

By MARIANO TIRONA

Of the Division of Soils and Fertilizers, Bureau of Science, Manila

and

ANGEL S. ARGÜELLES

Assistant Director, Bureau of Science, Manila

About the latter part of April, 1931, an inspection was made of certain abacá sections in Davao Province and first-hand information was gathered about the reported inferior growth and decreased fiber yield of abacá in renovated fields. The places particularly inspected were Bago and Daliao in the municipality of Davao, and the southern part of the municipal district of Guianga, which includes Mananbulan, Naming, Wangan, and Bayabas, where new and old plantations are found. Because of the drought, which lasted from January to the last week of April, abacá was dying in these places at the time of inspection, except in Bayabas, which is situated at a much higher altitude. The extent of the damage caused by the drought may be estimated at from 20 per cent in some plantations to 80 per cent in others. Of the three varieties; to wit, the Tangongon, the Maguindanaw, and the Bongolanon, which are most commonly grown in Davao, the Tangongon has been observed to be the most resistant to drought.

AGE OF PLANTATION AND FIBER YIELD

Yield in the first planting.—The first harvest of the fiber takes place eighteen months or two years after the seedling has been planted, depending upon the variety of abacá. The yield in

the first harvest is very little, being only a few piculs per hectare. In the second harvest, or the third year after planting, the yield is already normal and increases to the fifth year; from the sixth to the ninth year, the yield is almost equal that of the third year; but from the tenth to the nineteenth year it actually decreases, until in the twentieth year in some fields, and in the twenty-fifth year in others, it is hardly worth while extracting the fiber, for the amount of it obtained per hectare, under normal conditions of supply and demand, barely leaves a margin of profit. When a field has reached this stage it becomes necessary to renovate it entirely.

The following data pertaining to three fields of different ages situated in Bago give an idea of the yearly production of fiber in the first planting. They were kindly furnished by the field superintendent of the Ohta Development Company.

Field E; 7 years old.

Year.	Piculs per hectare.
Second	10
Third	50
Fourth	70
Fifth	70
Sixth	50
Field F; 20 years old.	
Second	10
Third	50
Fourth	
Fifth	70
Sixth	50
Seventh	70
Eighth	50
Ninth	40
Tenth	35
Eleventh to fifteenth	30
Sixteenth to twentieth	20

Field G, which is 25 years old, had produced the same average as field F from the third to the twentieth year, but in the twenty-fifth year it produced only an average of about 15 piculs per hectare.

Yields in the second planting.—The renovation of plantations which have been continuously grown with abacá for a score of years or more is a recent general practice. Of the several renovated fields inspected only two had abacá older than two years. Sufficient data, therefore, regarding the fiber yields in the second planting are as yet unavailable, although such information as was obtained was to the effect that in the third year of the second

planting an average of 30 to 50 piculs could be obtained from every hectare.

Comparison of yields.—In comparing fiber yields two other factors, besides climate and soil, must be taken into consideration: one may be called consequential, and the other personal. The consequential factor is intimately connected with the fluctuation of the market price of the fiber. When this price is such that the planters receive a good margin of profit, the abacá fields are properly cared for, and as a consequence the stalks grow fast and large and a good number of suckers issue forth. This results in greater fiber yield per unit area. When the price of the fiber is low, or very low, as it has been for some time, the plantations receive but little, if any, care. This neglect causes retardation of growth, hinders the production of suckers, and results in decreased fiber yield.

The personal factor, which is one of management, causes a similar variation; that is to say, the growth of abacá and the increase or decrease in the fiber yield depends in a large measure upon the care given to the plantation.

It is clear from the foregoing information that in practically all instances a real comparison of yields between given periods for any one planting would be misleading, and if this is so, it would be much more misleading to compare the yields from one planting with those from another. In the present instance and at this time, at least, even if data for second plantings were available, this comparison could not properly be made, because:

(*a*) Records of yields for first plantings had not been kept as a rule, and some such yields as given were based on mere impression or belief. Presently, even if figures on yields for first plantings were available, still comparisons of these figures with the corresponding ones for second plantings could be made only several years afterwards, when the plants of the latter planting had completely or sufficiently recovered from the several effects of the last drought.

(*b*) Some of the varieties, like the Libuton and Baguisanon, which had constituted not an inconsiderable part of first plantings and which have been found to yield less and weaker fiber than the varieties now being planted, have not been replanted upon renovation of the plantation.

(*c*) Under the prevailing method of extracting the fiber, which was adopted a few years ago, in which method a small spindle machine takes the place of man power, more fiber goes to waste than by the old hand-pulling method.

THE CAUSE OF THE REPORTED INFERIOR GROWTH AT THE SECOND PLANTING

The fact, however, remains that, according to observation, the growth of abacá of the second planting compares unfavorably with that of the first. Here is a problem that calls for serious study on account of its important bearing upon the proper and successful maintenance of the abacá industry of the country.

In the absence of noticeable pathological causes and adverse weather conditions to which the inferior growth of abacá may be ascribed, and considering the length of time during which the soil has been in this crop before the renovation of a plantation takes place, it is but proper to trace the source of the trouble to the soil as the principal factor of growth. Therefore, field studies of the reaction and physical characteristics of the soils of representative fields, as well as laboratory determinations of the amounts, both total and available, of the essential plant food elements present in them have been made.

Description of soils.—As above stated, the districts where the present investigation was undertaken are Bago and Daliao in the municipality of Davao, and the southern part of the municipal district of Guianga. The soil from Bago to Daliao, and from Daliao north to Wangan, Guianga, is practically uniform, being mostly a brown or reddish brown loam grading into a friable clay loam underlain by a friable clay which becomes waxy with depth. The average depth of the soil is about 18 centimeters. The subsoil, to the depth of 90 centimeters, consists of two layers; the one immediately below the A horizon being a brown or reddish brown friable clay loam grading into a clay, and the other a waxy clay. The type occupies an undulating to rolling topography and is well drained.

The soil in Bayabas is lighter in texture, being a brown or yellowish brown loam, about 25 centimeters deep on the average, underlain by a reddish brown friable but heavier loam. Throughout the depth of 90 centimeters, the subsoil is almost uniform. This type occupies a rolling topography and is well drained.

In the section where the representative soil type is a loam on clay, ten fields were selected, as follows:

Field A. In Naming, Guianga. Recently opened land.
Field B. Adjoins Field A. A first planting, nearly 10 years old.
Field C. In Wangan, Guianga. A recently cleared forest.
Field D. Adjoins Field C. A first planting, about 3 years old.
Field E. In Bago. A first planting, 7 years old.

Field F. In Bago. A first planting, 20 years old.
Field G. In Bago. A first planting, 25 years old.
Field H. In Daliao. A first planting, 25 years old.
Field I. In Daliao. A second planting, the abacá about 10 years old.
Field J. In Daliao. A third planting, the abacá is about 3 years old.

In the section where the representative soil type is a loam on loam four fields, all situated in Bayabas, Guianga, were chosen, as follows:

Field K. A first planting, about 1 year old.
Field L. A first planting, about 3 years old.
Field M. A first planting, about 3 years old.
Field N. A first planting, about 10 years old.

The reaction and plant food resources of the soils of the several fields.—The results of reaction tests in the field and of analyses of the soil and subsoil are presented in Tables 1 and 2. The top soil samples were taken to the depth of 15 centimeters, and the subsoil samples to the depth of 90 centimeters. The available phosphorus was determined by Frap's method, and the available potash, lime, and magnesia were determined by the base exchange method. The humus or organic carbon was not determined, because the soils are well supplied with organic matter owing to the fact that in harvesting the fiber about 98 per cent of the plant, consisting of leaves, nonfibrous parts of the pseudostem, and discarded portions of the *tuxie*, or fibrous strips, is left on the field and upon decomposition incorporated in the soil.

The pH values appearing in column 6 of Table 1 seem to show that, to the depth of 15 centimeters, soils of the same type vary in reaction depending on the length of time during which they have been in abacá, this reaction becoming, in general, less acidic as the field gets older; and that identical soils planted recently and for the first time, or in their virgin state, are acidic. Thus, the soil of field E, which is 7 years old, has a pH value of 6.2; but the soils of fields F and G, which are 20 and 25 years old, respectively, and situated in the same neighborhood as field E, have correspondingly pH values of 6.8 and 7.0. The soils of fields H, I, and J, which have been in abacá for not less than 25 years, give reactions that tend toward alkalinity. Again, the soil of field A, recently cleared virgin land, is more acidic than that of the adjoining field B, which is 10 years old. This decrease in acidity of the soils of the old fields may be due to the periodical incorporation in the soil of the organic matter which is left on the field as a result of the decomposition of those parts of the plant which are discarded during the harvest of the fiber;

for, as Stephenson [1] has found, "every organic treatment without lime has diminished the true acidity of the soil."

TABLE 1.—*Analysis of surface soil (15 centimeters deep) (moisture-free basis).*

Field.	District.	Age of field in—		Time elapsed between last stripping and soil sampling.	Soil reaction at time of sampling.[a]
		First planting.	Second planting.		
		Years.	*Years.*	*Weeks.*	*pH.*
A	Naming, Gulanga	(b)			6.4
B[c]	do	10		3	6.8
C	Wangan, Gulanga	(b)			6.4
D[d]	do	3		3	6.4
E	Bago, Davao	7		6	6.2
F	do	20		12	6.8
G	do	25		4	7.0
H	Daliao, Davao	25		3	7.2
I	do		10	5	7.2
J	do		(e) 3	3	6.8
K[f]	do	1			4.2
L	Bayabas, Gulanga	3		½	5.0
M	do	3		4	6.4
N	do	10		5	6.0

Field.	Total plant food.					Available plant food.			
	(N)	(P_2O_5)	K_2O	CaO	MgO	P_2O_5	K_2O	CaO	MgO
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
A	0.22	0.16	0.33	0.83	0.51	0.0029	0.1727	0.457	0.159
B[c]	.25	.17	.29	.81	.51	.0021	.1242	.311	.246
C	.24	.22	.25	.69	.53	.0022	.1649	.272	.213
D[d]	.24	.26	.21	.69	.53	.0031	.1422	.275	.129
E	.21	.17	.44	.80	.46	.0016	.1417	.441	.121
F	.22	.26	.63	1.66	.56	.0083	.1017	.643	.154
G	.20	.22	.40	.81	.66	.0021	.1238	.360	.126
H	.23	.19	.39	.90	.80	.0022	.0765	.475	.091
I	.26	.29	.37	.98	.67	.0026	.1184	.502	.080
J	.26	.23	.53	.97	.82	.0029	.1220	.476	.093
K[f]	.27	.20	.38	.52	.28	.0013	.1475	.139	.141
L	.40	.21	.39	.92	.23	.0015	.1528	.282	.135
M	.26	.19	.40	.73	.42	.0016	.0979	.348	.146
N	.27	.11	.34	.46	.44		.1056	.247	.183

[a] Determined colorimetrically using the La Motte soil testing set.
[b] Recently cleared land.
[c] Contiguous to and the same soil as A.
[d] Contiguous to and the same soil as C.
[e] Third planting.
[f] Contiguous to and same soil as L.

[1] Stephenson, R. E., The effect of organic matter on soil reaction, Soil Sci. 12 (1921) 145.

TABLE 2.—*Analysis of subsoil (15 to 90 centimeters) (moisture-free basis).*

Field.	Reaction at time of sampling.	Total plant food.				
		N	P_2O_5	K_2O	CaO	MgO
	pH.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
A	5.0	0.079	0.150	0.26	0.44	0.37
B						
C	6.4	.096	.220	.28	.48	.26
D	5.4	.092	.230	.31	.38	.29
E	5.2	.094	.067	.26	.53	.46
F	6.4	.074	.073	.68	.76	.51
G	6.2	.095	.110	.47	.44	.51
H	6.6	.086	.120	.22	.62	.65
I	6.8	.096	.130	.27	.62	.55
J	5.6	.092	.160	.19	.53	.86
K	4.4	.160	.200	.31	.52	.42
L	4.6	.130	.130	.30	.81	.47
M	5.4	.120	.092	.32	.43	.34
N	4.8	.045	.076	.19	.20	.08

The table incidentally seems to show that the loam on loam soils of Bayabas, which are situated at a high altitude, are more acidic than the virgin loam on clay loam soils found at the much lower level, in Bago and Daliao. The same appears to be true in the case of the subsoils, as shown in Table 2.

It might perhaps be supposed that the condition or state of decomposition of the plant wastes left on the fields incidental to the extraction of the fiber would influence the aforesaid reactions, but a correlation of the data in column 2, Table 2, and in column 5, Table 1, with those in column 6 of the latter table does not seem to warrant this supposition.

As regards the plant food constituents in the soils of the several fields investigated, the data in the tables are not, for any one kind of these constituents, comparable with one another, because nothing is known as to the amounts of them originally present. On the other hand, the figures show that, for the same soil type where the growth of abacá is to all appearances the same, in both the soil and the subsoil the quantities of essential plant food elements, except nitrogen, differ rather significantly for the several fields, and such differences have no relation to the ages of these fields. The figures seem also to show that, regardless of the age of the plantation, these quantities are adequate for the normal growth of the crop, if the analyses of the soils of fields A and G, which are recently cleared virgin lands, or those of fields B, F, and K, which are 10, 7, and 1 years old, respec-

tively, are taken as the criterion. Judged by the same standard the available plant nutrients seem likewise to be adequate, but just as in the case of the total, they do not correlate with the ages of the fields, as disclosed by a cursory inspection of the data in the last four columns of Table 1. Such lack of correlation may perhaps be due partly to the fact that a great proportion of the nutrients existing in available form in the soil were derived from the unequal amounts of plant wastes which were left and allowed to decompose on the field incidental to the extraction of the fiber. Some importance should, however, be attached to the comparatively very low amounts of available magnesium in the oldest fields (H, I, and J), which may be one of the limiting factors of growth in the second planting.

It should be noted in connection with this discussion that the amounts of essential plant food elements removed from a hectare of soil as fiber constituents in the twenty years during which the crop of the first planting is supposed to last, seem to be unimportant, as will be shown. When fiber of good cleaning grade is produced, as it is generally produced in Davao, practically 98.5 per cent of the above ground part of the plant remains on the field and only 1.5 per cent is removed as fiber. Analysis of abacá fiber of excellent cleaning made in the Bureau of Science shows that this grade contains, on an average, 0.080 per cent nitrogen (N), 0.012 per cent phosphoric anhydride (P_2O_5), 0.428 per cent potash (K_2O), and 0.164 per cent calcium oxide (CaO). Now, fiber of excellent cleaning is only one grade higher than fiber of good cleaning, so that for the purpose of having an idea of how much plant food has been removed as fiber constituents from a hectare of soil for a given period of time these values may be conveniently used. The production in twenty years, as stated elsewhere in this paper, is about 695 piculs, or 43,933 kilos of fiber of good grade, per hectare. Based on the above percentages, this weight of fiber has removed from a hectare of soil 35.146 kilos of nitrogen, 5.272 kilos of phosphoric anhydride, 188.034 kilos of potash, and 72.050 kilos of calcium oxide. These quantities of nutrients constitute, with the exception of potash, but a very small fraction of even the available plant food resources in a hectare of any one of the soils herein described after twenty or twenty-five years of cropping, and can be readily replaced by a ton of fertilizer having the composition of 3.51 per cent nitrogen, 0.53 per cent phosphoric acid, 18.80 per cent potash, and 7.03 per cent lime.

It can be seen from the foregoing that an explanation of the cause of the reported inferior growth of abacá of the second planting based upon the insufficiency of the plant food elements in the soil would be unsatisfactory, but that field observation and laboratory results tend to show that this inferior growth may be due to the decreased acidity or to a reaction change towards alkalinity of the soil as a consequence of its long continuous cropping. However, plot experiments should be carried on over a period of years to supplement these observations on the relationship between abacá growth and the age of plantation.

ACKNOWLEDGMENT

Thanks are due to Mr. Tsutaya, of the agricultural department of the Furukawa Plantation Company, and to the officials and employees of the Ohta Development Company, particularly to U. Kojima and the gentleman in charge of the plantation in Bago, Davao, for valuable information and assistance given in the field.

EXPERIMENTAL INQUIRY INTO THE TRANSMISSION OF RAT-BITE FEVER AMONG RATS: PART I

By SHIZUKA ARIMA[1]

Of the Division of Biology and Serum Laboratory, Bureau of Science, Manila

Rat-bite fever is essentially an epizoötic of rats. In a great majority of human cases the history is too definite to leave any doubt as to the manner of transmission of the disease from rats to humans. The name of the disease has been coined accordingly. Yet cases of human rat-bite fever have been noted by experienced physicians in which the history was obscure or indefinite with regard to rat bite, an occurrence that could remain unnoticed by any person.

Experimental evidence teaches us (*a*) that highly susceptible rodents may live peacefully along side of an infected mate for a long time without contracting rat-bite fever, but that an infected rodent will inevitably convey the disease to his healthy mates by bite if a combat takes place among these animals; (*b*) that the disease, in its acute stage, may produce abortion among rodents, but the evidence as to congenital transmission of the disease has been uniformly negative; (*c*) that rat-bite fever assumes a chronic form among rodents in which a condition of latency, so to speak, may be reached, when the parasites can no longer be found by microscope in the blood or in the tissues, but their presence in the internal organs can be demonstrated by transfers of the organs to normal, susceptible, experimental animals. These are every-day experiences with the disease in the laboratory.

As far as we know, the disease is not transmitted from man to man, and this mode of spreading is not probable in rat-bite fever. The disease is maintained and propagated among and by rats.

The only mode of transmission of the disease among these animals that is positively known and is the easiest to accomplish under laboratory conditions is that by direct bite. This mode alone of conveying the disease explains satisfactorily the prevalence of rat-bite fever among rats if one considers the

[1] Surgeon, Lieutenant Commander, Imperial Japanese Navy.

enormous fertility of these animals and the frequent combats among them, either in the struggle for food or for male supremacy in a territory they inhabit.

Of other, less-common means of propagation of this disease among rats the bloodsucking insects, particularly fleas, and the ingestion of blood and organs of recently slaughtered antagonists occur to one's mind as most likely to play a part.

Urged by these considerations and hoping that the study of transmission by flea bite in particular might throw some light on the provenience of obscure human cases with negative rat-bite history, we undertook the three sets of experiments that are the subject of this communication.

First some information concerning the viability of the particular strain of spirochætes within the flea's body under the actual conditions of experiment was deemed essential. This question was considered in the first experiment.

An attempt to transmit the disease by the interrupted feeding of fleas on an infected host and subsequently on a healthy susceptible animal was the subject of the second experiment.

Susceptible normal experimental animals were allowed to feed on the blood and organs of infected ones in the third experiment, in order to inquire into the transmission of the disease by ingestion.

VIABILITY OF SPIROCHÆTA MORSUS MURIS ON OR IN THE BODY OF INFECTED FLEAS

TECHNIC

Fleas, secured from outside the laboratory, were allowed to take a full meal of blood, rich in spirochætes at the time of experiment, by sucking from an infected guinea pig. The fleas were put away under the best conditions available and from time to time samples of fleas were crushed, examined under dark-field microscope, stained slide, and inoculation to susceptible normal animals. The details and results are summarized in Tables 1 and 2. It may be mentioned in connection with these experiments that the time of the fleas, meals varied considerably. Although the length of mealtime was noted as necessary information for the arrangement of experiments in which interrupted feeding was used, it was not considered in the interpretation of the results. The lifetime of the captive fleas was often annoyingly brief. Thus it happened that at the expiration of the periods of time, as given in the tables, the fleas have been dead for some time. For this reason the time of exposure of spiro-

chætes in or on the body of fleas was limited to two hours in the animal experiment. It is believed, however, that the upper time limit of viability of *Spirochæta morsus muris* was reached.

Microscopic examination of infected fleas crushed and examined at a definite period of time revealed the presence of spirochætes typical in shape, size, and movement within one hour after feeding. After and including that period of time the spirochætes could no longer be discerned with certainty. Nonmotile, swollen, irregularly round or beaded forms were encountered under the dark-field. In such cases stained slides were at times more satisfactory.

The results of inoculation of crushed, infected fleas into guinea pigs agree with those obtained by microscopic examination. Animals inoculated with emulsion of infected fleas that were killed, crushed, and injected within one hour after they had fed on infected blood showed unmistakable signs of infection with *Spirochæta morsus muris*. Fleas that were crushed and inoculated to guinea pigs later than one hour after feeding failed to provoke symptoms of the disease.

ATTEMPT TO TRANSMIT RAT-BITE FEVER FROM ANIMAL TO ANIMAL BY FLEA BITE

TECHNIC

In each of five trials an infected guinea pig that showed sufficient number of spirochætes in the blood to be easily found by the dark-field microscope was selected as a donor on which fleas were fed. As soon as the flea had ingested a sufficient amount of the donor's blood to be noticeable to the naked eye the feeding was interrupted and the flea was placed on a normal recipient guinea pig to complete its meal. It was not always possible to induce the fleas to reassume feeding on the fresh guinea pig, and unless they did so within a short time they were discarded. Thus, only smoothly proceeding experiments are herewith reported, which are only a fraction of all the trials. The details of this experiment are summarized in Table 4.

With the exception of fever none of the symptoms of experimental rat-bite fever have been noticed in the animals that were repeatedly bitten by infected fleas under otherwise favorable conditions.

To carry the proof as far as present knowledge of the disease and technical procedures make it possible, the animals that had been repeatedly bitten by infected fleas were sacrificed and their spleens and lymphatic glands inoculated separately into

fresh normal guinea pigs. These remained healthy and negative as to symptoms of rat-bite fever.

ATTEMPT TO TRANSMIT RAT-BITE FEVER BY FEEDING BLOOD AND ORGANS CONTAINING SPIROCHÆTA MORSUS MURIS

TECHNIC

Infected blood and organs of a guinea pig were removed and immediately given to white mice as food. The presence of spirochætes was confirmed by dark-field examination. The white mice licked the blood and organs as soon as offered to them. However, they did not eat the organs. The feeding of the blood was repeated on two successive days, and on the third day the organs were fed to the same animals that ingested the infected blood previously. Blood was examined daily for spirochætes for three weeks but none were found.

The animals were sacrificed and their organs inoculated into a guinea pig. Blood was examined daily, and the fever curve was drawn.

Four days after the inoculation of the guinea pig there developed at the place of inoculation an induration, but spirochætes were not found in the serum obtained from the lesion, which disappeared in ten days. The temperature curve was not typical of the rat-bite fever and the animal remained alive.

The result of this experiment is negative. However, it is not conclusive, because the animals did not eat the organs.

SUMMARY

Experimental inquiry was conducted into the possibility of the transmission of rat-bite fever from rodent to rodent by flea bite and by ingestion of infected blood and organs of rodents, dead of the disease. As a preliminary experiment the viability of *Spirochæta morsus muris* in the flea's body was investigated.

Laboratory animals were used and local Manila strains of the spirochæte were employed.

DISCUSSION AND CONCLUSIONS

For the purpose of proper interpretation of the findings some reference to previous work on Manila rat-bite fever must be made.

The Manila strains of *Spirochæta morsus muris* have been found to be very virulent, invariably producing death in guinea pigs, rabbits, and monkeys. The viability of the Manila strains within the animal's blood when removed from the body has

been found to be much longer than that in the body of fleas. As these tests have been performed with the same strains and in the same laboratory they bear comparison. Considering previous findings with ours certain conclusions can be drawn, as follows:

1. The viability of *Spirochæta morsus muris* within the flea's body is of very short duration.

2. There is no evidence that a progressive multiplication takes place within the body of an infected flea. The evidence is to the contrary.

3. The part of fleas in spreading and maintaining rat-bite fever among rats or in transmitting the disease to humans is insignificant.

TABLE 1.—*Showing the results of microscopic investigation of crushed fleas.*

[+. Spirochæte found; relative number of spirochætes found is indicated by number of pluses.]

Examination No.	Hours after feeding.	Results.		Remarks.
		Dark-field.	Staining.	
1	(a)	++	++	Form, size, and motion are typical.
2	(a)	+++	+++	
3	(a)	+++	+++	
1	0.5	++	++	Do.
2	0.5	++	++	
3	0.5	++	++	
1	1.0	Doubtful	Doubtful	Organism thick, windings are not so typical, motility is not active.
2	1.0	do	do	
3	1.0	+	+	
1	2.0	Very doubtful	Doubtful	
2	2.0	Not found	Not found	
3	2.0	do	do	
1	4.0	Not found; flea dead	Doubtful	Windings lost; looks like stick form.
2	4.0	do	do	
3	4.0	Not found; flea living	Not found	
1	8.0	Not found; flea dead	Doubtful	In dark-field; in shape resembles *Spirochæta morsus muris*, but is nonmotile.
2	8.0	do	do	
3	8.0	do	do	
1	16.0	do	Not found	
2	16.0	do	do	
3	16.0	do	do	
1	20.0	do	do	
2	20.0	do	do	
1	24.0	do	Doubtful	Curved, beaded organism found on stained slide made from crushed dead flea, 24 hours after feeding. The organism resembled in general shape and size *Spirochæta morsus muris*.
2	24.0	do	do	

[a] Examined immediately after feeding.

4. This explains the character of endemics and outbreaks of the disease, which unlike plague occurs in the form of isolated cases.

5. Our experiments concerning the transmission of rat-bite fever by ingestion are not conclusive.

TABLE 2.—*Showing the results of experiments concerning the viability of Spirochæta morsus muris in the body of fleas.*

[Test for viability performed by injection of crushed fleas to susceptible animals. All fleas alive; +, found; —, not found.]

Recipient guinea pig No.	Fleas inoculated.	Time after feeding the fleas.	Manifestations of the disease in guinea pig.		
			Fever.	Local lesion.	Spirochætes.
M-176	May 6, 1932	Immediately	+	+	+
M-181	May 6, 1932	One hour	+	—	+
M-182	May 6, 1932	Two hours	—	—	—
M-186	July 30, 1932	Immediately	+	+	+
M-189	July 30, 1932	One hour	+	—	—
M-188	July 30, 1932	Two hours	—	—	—

TABLE 3.—*Showing the length of time of feeding of fleas on donor (feeding) and on recipient (biting).*

Date of experiment.	Flea No.	Feeding on donor.	Biting recipient.	Recipient No.
		Mins.	*Mins.*	
May 6, 1932	F-1	2	1	M-174
May 6, 1932	F-4	1	1	M-174
May 6, 1932	F-8	2	0.5	M-174
June 12, 1932	F-2	5	0.5	M-174
June 12, 1932	F-5	2	4	M-174
June 12, 1932	F-9	2	5	M-174
July 30, 1932	F-3	3	7	M-174
July 30, 1932	F-5	3	5	M-174
July 30, 1932	F-8	1	6	M-174
August 9, 1932	F-1	2	1	M-174
August 9, 1932	F-5	2	1.5	M-174
August 9, 1932	F-6	2	1	M-174
August 8, 1932	F-1	2	4	M-190
August 8, 1932	F-4	3	5	M-190
August 8, 1932	F-4	3	5	M-190
September 3, 1932	F-2	2	3	M-190
September 3, 1932	F-2	2	3	M-190
September 3, 1932	F-6	3	3	M-190

TABLE 4.—*Showing the results of experiments concerning transmission of rat-bite fever from animal to animal by means of flea bites.*

[Test performed by interrupted feeding of fleas on infected and then on normal experimental animals.]

Date of experiment.	Guinea pig No. (recipient).	Manifestations.		
		Fever.	Lesion.	Spirochætes.
May 6, 1932	M-174	—	—	—
June 12, 1932	M-174	+	—	—
July 30, 1932				
August 9, 1932	M-174	+	—	—
August 8, 1932	M-190	+	—	—
September 3, 1932	M-190	+	—	—

ACKNOWLEDGMENT

To Dr. Otto Schöbl, former chief of the division of biology and serum laboratory, Bureau of Science, Manila, I wish to express my appreciation for suggestions offered. I am particularly indebted to my predecessor, Lt. Col. H. Hirano, Imperial Japanese Army, who kindly supplied me with the strains of *Spirochæta morsus muris* which he isolated from patients in Manila.

STUDIES ON THE WEIGHTS OF VISCERAL ORGANS IN FILIPINOS [1]

By P. I. DE JESUS and W. DE LEON

Of the College of Medicine, University of the Philippines, Manila

In a series of papers we are reporting our studies on the weights of the principal visceral organs of normal and pathological cases in relation to age, length of body, and body weight with a view to establishing standards for Filipinos.

Bean (1) was the first to study the weights of vital organs in Filipinos. In his analysis of the various human types, he found that the organs were small in the slender type called hypermorph and large in the stocky type called mesomorph, or in the hypomorph, the infantile adult. Supplementing his studies in Manila with further data in the United States, he pointed out the difference in size of the organs in relation to such factors as race, sex, stature, nutrition, age, and disease. Nañagas (2) also reported a study on the dimensions of kidneys in Filipinos but without reference to weights.

Sitsen (3) reported his investigations on the weights of several organs among the Malays of Java. His study is particularly important to us for purposes of comparison since the Filipinos are predominantly Malays. Castor, (4) in India, reported the weights of organs of East Indians and Burmans.

In Europe and America investigations of this nature are profusely quoted in standard works of anatomy and pathology by well-known authors, including Jackson, (5) Piersol, (6) Cunningham, (7) Orth, (8) and Vierordt. (9) Scammon (10) cited Muller, Gundobin, Bovaire, Nicholl, Lorey, Notori, Oppenheimer, Harley, Kowalski, Thoma, Starck, and others, in their reports on the weights of various visceral organs in Occidental races.

Our studies are based on more than 11,000 necropsy records of the Department of Pathology and Bacteriology of the University of the Philippines, from 1907 to 1924, and more than 1,000 cases of the Department of Legal Medicine of the same university,

[1] Read before the Second Philippine Science Convention, February 16, 1933.

from 1925 to 1931. We here record our appreciation of the help of these two departments in this matter.

During the performance of post-mortems all important organs were weighed and measured in the fresh state previous to cutting and examination and before placing them in preservatives. The weights were taken continuously by the same persons during the period included in our series.

We are reporting our studies in several papers. This first paper is intended to serve as an introduction. The second will be confined to a study of the weights of normal organs in infants and children from birth to adolescence. The third paper will be concerned with the weights of organs in adult Filipinos at different ages. The fourth will deal with the weights of organs in relation to length and body weight, and the fifth and last paper of the series will discuss the weights of organs in pathological conditions.

BIBLIOGRAPHY

1. BEAN, R. B. Notes on the weight of some vital organs—their development, variability and relation to disease—a summary. Virginia Med. Month. 53 (1926) 692–697.
2. NAÑAGAS, J. C. Position and size of the kidneys among Filipinos. Philip. Journ. Sci. 18 (1921) 695–705.
3. SITSEN, A. E. The normal weight of several organs with Malay race. Mededeelingen van den Dienst der Volksgezondheid in Nederlandsch-Indie. Foreign ed., Part III (1927) 490–499.
4. CASTOR, R. H. Weights of organs. Journ. Trop. Med. and Hyg. 15 (1912) 17–24.
5. JACKSON, C. M. Morris' Human Anatomy. 8th ed. P. Blakiston's Son & Co., Philadelphia (1925).
6. PIERSOL, G. A. Human Anatomy. J. B. Lippincott Co., Philadelphia (1907).
7. CUNNINGHAM, D. J. Textbook of Human Anatomy. Edited by A. Robinson. 5th ed. Wm. Wood & Co., New York (1918).
8. ORTH, J. Lehrbuch der Speciellen Pathologischen Anatomie. August Hirschwald, Berlin (1887, 1893). 2 vols.
9. VIERORDT, H. Anatomische Physiologische und Physikalische Daten und Tabellen zum Gebrauche für Mediziner. Gustav Fischer, Jena (1906).
10. SCAMMON, R. E. Tables of fetal measurements. Institute of Anatomy, University of Minnesotta. (Unpublished.)

NORMAL WEIGHTS OF VISCERAL ORGANS IN FILIPINO CHILDREN[1]

By P. I. DE JESUS, W. DE LEON, and P. ANZURES

Of the College of Medicine, University of the Philippines, Manila

ONE TEXT FIGURE

Information on the weights of normal visceral organs in children is of importance not only for academic study but also in actual practice, especially in medicolegal and court investigations. The knowledge of normal weights of organs at different ages finds practical application in the determination of the probable age of unidentified children, victims of accidents or foul play. This knowledge will corroborate and supplement other findings; such as the external measurements of the body, the number and condition of the teeth, and other developmental characteristics.

Furthermore, the knowledge of the normal weights of organs would be of service as a basis for comparison in deciding pathological variations in the weights of these same organs.

The present paper will be confined to the determination of the weights of normal visceral organs in infants and children from birth to adolescence. These include stillborn, newborn, infants, and children under 16 years of age that died due to violence or accidents.

The stillborn and newborn included in this study were full-term babies that died as a result of manipulation during delivery. The other children died by drowning, falls, automobile accidents, extensive burns, and other violent influences. These cases were normal children previous to their death, suffering from no previous pathologic condition that might in any way affect the weight of the organs. In all cases, death occurred soon after the accident so that not much change could have taken place in the visceral organs to materially alter the weights. In this group we have collected 338 cases—243 males and 95 females.

[1] Read before the Second Philippine Science Convention, February 16, 1933.

RESULTS OF INVESTIGATION

Tables 1 to 10 show summaries of our findings and give the absolute average weights of normal visceral organs in Filipino children classified according to age at the time of death. From these tables it will be seen that the heart, spleen, liver, pancreas, and kidneys increase in weight more rapidly during the first year than during any other age. Bean(1) also observed the rapid growth of each organ after birth, but he also mentioned a second period of rapid growth a few years later, and a third period about puberty. In our studies, however, we observe that in general after the first year of age, the yearly gain in weight appears to be more or less constant, and may be represented by the slope of a straight line whose empirical formula can be determined by graphic method.

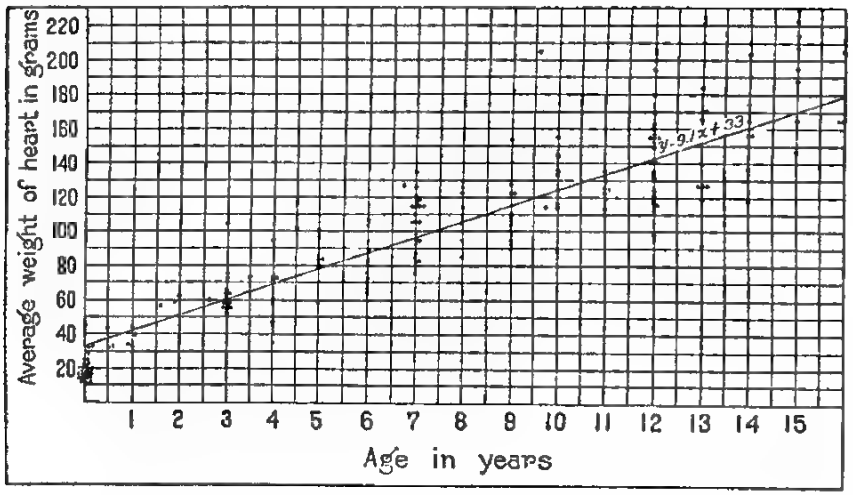


FIG. 1. Graph of average normal weights of the heart in male Filipino children.

For illustration we present in fig. 1 a graph made by plotting the individual weights of the heart in male children at different ages. Each dot in the figure represents the observed weight of the heart for each individual case. The solid line represents the approximate curve of the averages of these observations.

It will be noted that the curve for the males shows an increasing weight of a more or less constant rate after the age of 1 year, and follows the approximate course of a straight line which may be expressed by the equation, $y = 9.1x + 33$, where

y is the weight of the heart in grams, x the age of the child in years, 9.1 (slope of the line) the yearly gain in weight of the heart in grams, and 33 (y-intercept of the line) a constant.

Similarly, the curves for the other organs have been found to approximate straight lines and their equations have been determined by us. The equations for all the organs studied are as follows:

Heart:
Male, $y = 9.1x + 33$.
Female, $y = 8.6x + 32$.

Spleen:
Male, $y = 3.8x + 30$.
Female, $y = 3.8x + 24$.

Liver:
Male, $y = 51x + 240$.
Female, $y = 50x + 220$.

Pancreas:
Male, $y = 4.2x + 11$.
Female, $y = 4.2x + 8$.

Suprarenal gland, right:
Male, $y = 0.15x + 3.4$
Female, $y = 0.15x + 3.1$.

Suprarenal gland, left:
Male, $y = 0.17x + 3.6$.
Female, $y = 0.16x + 3.4$

Kidney, right:
Male, $y = 4.5x + 24$.
Female, $y = 4.2x + 24$.

Kidney, left:
Male, $y = 4.7x + 25$.
Female, $y = 4.4x + 25$.

The above formulæ, however, are not applicable to children less than 1 year of age, for in these cases the gain in weight of the organs is more rapid. For instance, in male infants the weight of each of these organs nearly doubled itself in the first six months and nearly trebled at the end of the first year. In the female infants we are unable to state definitely the increase in the rate of growth due to insufficient number of cases in the series.

The suprarenal glands, unlike the other organs, tend to decrease in weight during the first six months in both sexes, but later the gain in weight becomes also constant and uniform.

It will be noted from Tables 1 to 10 that the visceral organs of the males are uniformly heavier than those of the females for all ages. Comparing with tables of Vierordt(2) it is observed that Filipinos are born with slightly lighter organs than Europeans. After birth, however, it is interesting to note that the absolute weights of the principal visceral organs in Filipino children, with the exception of the kidneys, compare favorably with those of Occidentals, especially in their early years. These findings are verified by the reports of Muller, Gundobin, Bovaire, Nicholl, Lorey, Notori, Oppenheimer, Harley, Kowalski, Thoma, Starck, and others, cited by Scammon.(3)

TABLE 1.—*Average normal weights of the heart in Filipino children.*

Age.	Male.			Female.		
	Cases.	Heart, average weight.	Probable error.	Cases.	Heart, average weight.	Probable error.
Yrs.		*g.*	*g.*		*g.*	*g.*
Stillborn	9	18.22	±1.40	9	20.11	±0.79
Newborn	28	18.04	±0.83	8	17.38	±0.61
Under 1	10	37.80	±4.25	5	24.60	±1.91
1–2	8	45.63	±2.47	7	51.00	±1.96
2–3	2	61.00	----------	7	49.71	±1.80
3–4	20	63.75	±1.72	9	62.89	±3.34
4–5	11	73.45	±3.48	5	75.00	±3.98
5–6	10	81.00	±4.11	8	83.88	±3.60
6–7	12	83.92	±3.60	3	90.67	----------
7–8	26	103.62	±2.06	6	80.33	±5.35
8–9	9	109.22	±3.13	4	100.25	----------
9–10	15	110.67	±3.32	5	97.80	±4.09
10–11	7	135.00	±3.98	2	125.50	----------
11–15	76	159.32	±3.48	17	167.00	±5.92

TABLE 2.—*Average normal weights of the spleen in Filipino children.*

Age.	Male.			Female.		
	Cases.	Spleen, average weight.	Probable error.	Cases.	Spleen, average weight.	Probable error.
Yrs.		*g.*	*g.*		*g.*	*g.*
Stillborn	7	9.71	±1.16	7	8.43	±0.71
Newborn	24	6.92	±0.39	9	10.22	±0.99
Under 1	8	23.88	±3.74	6	18.17	±1.98
1–2	8	40.75	±3.65	7	38.14	±2.18
2–3	2	62.00	----------	6	39.17	±2.33
3–4	19	50.74	±2.26	8	38.25	±1.47
4–5	10	42.80	±2.03	7	40.87	±2.28
5–6	9	45.89	±2.03	10	51.20	±3.04
6–7	11	42.00	±2.21	3	45.67	----------
7–8	25	59.00	±2.45	7	36.57	±3.49
8–9	10	67.40	±5.50	5	61.20	±6.61
9–10	13	59.54	±2.31	1	54.00	----------
10–11	8	63.38	±6.15	3	84.67	----------
11–15	73	86.52	±2.67	17	104.53	±7.16

TABLE 3.—*Average normal weights of the liver in Filipino children.*

Age.	Male.			Female.		
	Cases.	Liver, average weight.	Probable error.	Cases.	Liver, average weight.	Probable error.
Yrs.		*g.*	*g.*		*g.*	*g.*
Stillborn	6	138.17	± 8.26	7	148.00	± 7.00
Newborn	18	104.17	± 4.33	8	123.63	± 5.79
Under 1	8	242.00	±32.36	5	165.60	±15.49
1–2	5	305.80	±14.37	8	342.75	±37.33
2–3	2	401.00		7	351.14	±19.16
3–4	15	430.53	±12.58	8	363.00	±14.65
4–5	8	435.63	±16.90	4	510.75	
5–6	9	580.89	±29.68	6	515.00	±22.42
6–7	11	543 64	±26.54	1	675.00	
7 8	19	625.42	±20.12	5	489.00	± 19.72
8–9	10	704.50	±26.21	5	686.00	±36.88
9–10	10	624.60	±18.76	4	673.25	
10–11	6	805.17	±43.15	3	628.00	
11–15	60	893.55	±16.31	15	866.60	±45.91

TABLE 4.—*Average normal weights of the pancreas in Filipino children.*

Age.	Male.			Female.		
	Cases.	Pancreas, average weight.	Probable error.	Cases.	Pancreas, average weight.	Probable error.
Yrs.		*g.*	*g.*		*g.*	*g.*
Stillborn	2	1.50		1	4.00	
Newborn	6	3.17	±0.19	3	4.00	
Under 1	2	11.00				
1–2	1	17.00		3	17.67	
2–3				1	22.00	
3–4	4	28.75		1	27.00	
4–5				2	22.00	
5–6	1	29.00		2	27.00	
6–7	2	36.00		1	30.00	
7–8	8	46.25	±2.70	2	47.00	
8–9						
9–10	3	43.33		2	53.50	
10–11	5	56.60	±3.68	2	49.00	
11–15	15	60.27	±2.47	5	63.80	±4.16

TABLE 5.—*Average normal weights of both suprarenals in Filipino children.*

Age.	Male.			Female.		
	Cases.	Both suprarenals, average weight.	Probable error.	Cases.	Both suprarenals, average weight.	Probable error.
Yrs.		*g.*	*g.*		*g.*	*g.*
Stillborn	5	7.00	±0.47	8	12.38	±0.76
Newborn	21	8.33	±0.31	9	9.22	±0.55
Under 1	6	6.67	±0.67	3	7.33	
1–2	2	6.00		4	6.75	
2–3				1	6.00	
3–4	9	6.22	±0.49	3	6.00	
4–5	4	7.00		6	5.00	±0.28
5–6	5	8.60	±0.70	3	6.67	
6–7	4	11.00				
7–8	14	8.93	±0.70	3	8.00	
8–9	4	8.75		2	9.00	
9–10	8	10.25	±0.56	3	7.33	
10–11	5	9.80	±0.64	3	10.33	
11–15	36	10.08	±0.36	10	12.10	±0.97

TABLE 6.—*Average normal weights of the right suprarenal in Filipino children.*

Age.	Male.			Female.		
	Cases.	Right suprarenal, average weight.	Probable error.	Cases.	Right suprarenal, average weight.	Probable error.
Yrs.		*g.*	*g.*		*g.*	*g.*
Stillborn	1	3.00		1	7.67	
Newborn	8	4.25	±0.10	1	4.00	
Under 1	3	4.00		1	4.00	
1–2	2	3.00		2	4.50	
2–3				3	3.00	
3–4	6	3.17	±0.33	2	2.00	
4–5	4	3.50		2	2.00	
5–6	5	4.20	±0.30	1	5.00	
6–7	4	5.00				
7–8	9	4.56	±0.37	2	4.00	
8–9	3	4.67		2	4.00	
9–10	4	5.50		2	5.00	
10–11	4	5.00		3	4.67	
11–15	22	5.36	±0.18	9	5.78	±0.59

TABLE 7.—*Average normal weights of the left suprarenal in Filipino children.*

Age.	Male.			Female.		
	Cases.	Left suprarenal, average weight.	Probable error.	Cases.	Left suprarenal, average weight.	Probable error.
Yrs.		*g.*	*g.*		*g.*	*g.*
Stillborn	1	3.00	----------	3	8.33	----------
Newborn	8	4.00	±0.24	3	4.33	----------
Under 1	3	4.67	----------	1	4.00	----------
1–2	2	3.00	----------	2	5.00	----------
2–3	----------	----------	----------	3	3.33	----------
3–4	6	3.50	±0.35	2	2.00	----------
4–5	4	3.50	----------	2	3.50	----------
5 6	5	4.40	±0.45	1	5.00	----------
6–7	4	6.00	----------	----------	----------	----------
7 8	9	5.00	±0.58	2	4.00	----------
8–9	3	5.67	----------	2	5.00	----------
9–10	4	4.75	----------	2	4.00	----------
10–11	4	5.00	----------	3	5.67	----------
11–15	22	6.18	±0.33	9	6.78	±0.46

TABLE 8.—*Average normal weights of both kidneys in Filipino children.*

Age.	Male.			Female.		
	Cases.	Both kidneys, average weight.	Probable error.	Cases.	Both kidneys, average weight.	Probable error.
Yrs.		*g.*	*g.*	*g.*	*g.*	*g.*
Stillborn	6	23.33	±1.05	8	26.13	±1.40
Newborn	24	25.08	±1.04	10	28.10	±1.98
Under 1	7	53.14	±6.00	5	41.20	±4.97
1–2	5	60.80	±3.23	5	63.60	±3.12
2–3	2	78.00	----------	4	68.00	----------
3–4	16	73.19	±2.24	3	79.00	----------
4–5	6	79.50	±3.76	7	88.29	±2.98
5–6	10	104.40	±3.51	8	93.75	±3.03
6–7	12	99.33	±4.34	3	86.00	----------
7–8	21	110.90	±3.30	6	89.67	±4.32
8–9	9	133 33	±5.74	3	127.67	----------
9–10	13	143.62	±9.51	4	124.50	----------
10–11	4	151.50	----------	2	157.00	----------
11–15	66	167.58	±3.40	15	173.73	±6.18

TABLE 9.—*Average normal weights of the right kidney in Filipino children.*

Age.	Male.			Female.		
	Cases.	Right kidney, average weight.	Probable error.	Cases.	Right kidney, average weight.	Probable error.
Yrs.		*g.*	*g.*		*g.*	*g.*
Stillborn	1	12.00	----------	3	14.33	----------
Newborn	8	13.13	±0.79	3	12.00	----------
Under 1	2	39 50	----------	1	32.00	----------
1–2	4	29.25	----------	5	30.40	±1.42
2–3	1	45.00	----------	4	35.25	----------
3–4	14	35.21	±1.31	3	38.67	----------
4–5	5	38.00	±1.10	1	39.00	----------
5–6	7	49.29	±1.35	6	46.17	±1.79
6–7	10	49.80	±2.45	3	41.33	----------
7–8	12	55.17	±2.37	4	43.75	----------
8–9	7	67.00	±4.01	3	64.00	----------
9–10	9	67.78	±6.51	2	52.00	----------
10–11	2	70.00	----------	2	77.50	----------
11–15	47	81.77	±2.05	13	83.23	±3.56

TABLE 10.—*Average normal weights of the left kidney in Filipino children.*

Age.	Male.			Female.		
	Cases.	Left kidney, average weight.	Probable error.	Cases.	Left kidney, average weight.	Probable error.
Yrs.		*g.*	*g.*		*g.*	*g.*
Stillborn	1	12.00	----------	3	16.00	----------
Newborn	8	14.13	±0.72	3	14.00	----------
Under 1	2	42.50	----------	1	35.00	----------
1–2	4	30.50	----------	5	33.20	±1.74
2–3	1	50.00	----------	4	32.75	----------
3–4	14	38.43	±1.12	3	40.33	----------
4–5	5	36.60	±1.87	1	40.00	----------
5–6	7	52.71	±2.72	6	47.67	±2.05
6–7	10	49.90	±2.75	3	44.67	----------
7–8	12	58.33	±2.93	4	46.25	----------
8–9	7	68.14	±3.91	3	63.33	----------
9–10	9	68.44	±6.42	2	65.00	----------
10–11	2	71.50	----------	2	79.50	----------
11–15	47	85.66	±2.11	13	88.15	±3.51

SUMMARY AND CONCLUSIONS

From a study of the weights of fresh visceral organs from 338 necropsies of Filipino children dying of traumata, we have developed empirical formulæ and standard tables of the absolute average normal weights of organs in Filipino children.

It is interesting to note that during the child's first year of life the gain in weight of the principal organs studied is more rapid than at any other age, with the exception of the suprarenal glands which diminish in weight during the same period.

After the first year and before the age of 16, the yearly gain in weight is more or less constant and uniform, and may be represented by the slope of the linear equation derived for each organ by standard graphic methods.

The formula of the curve of the weights of each organ at different ages should, in our opinion, help in estimating the average weight of the organ at any age between 1 and 15 years.

We believe that our tables of the standard average weights of normal organs will also be of service in solving certain medico-legal problems, and in deciding whether or not pathological changes have affected the weights of these organs.

BIBLIOGRAPHY

1. Bean, R. B. Notes on the weight of some vital organs—their development, variability and relation to disease—a summary. Virginia Med. Month. 52 (1926) 692–697.
2. Vierordt, H. Anatomische Physiologische und Physikalische Daten und Tabellen. Gustav Fischer, Jena (1906) 36–37.
3. Scammon, R. E. Tables of fetal measurements. Institute of Anatomy, University of Minnesota. (Unpublished.)

ILLUSTRATION

TEXT FIGURE

NORMAL WEIGHTS OF VISCERAL ORGANS IN ADULT FILIPINOS

By W. DE LEON, ARTURO GARCIA, and P. I. DE JESUS
Of the College of Medicine, University of the Philippines, Manila

Similar to our previous study(1) on the normal weights of organs in Filipino children, we present in this paper the normal weights in adult Filipinos. Our summarized report shown in Table 1 represents the absolute weights of the principal visceral organs taken in a fresh state during post-mortem examinations.

Our data in this study includes 768 cases that died of violence or accidents, of which 620 were males and 148 females. The causes of death included drowning, falls, automobile accidents, extensive burns, shooting, stabbing, strangulations, lightning shocks, electrocutions, and the like. The deaths were almost always immediate and not preceded or accompanied by any known pathologic state.

For purposes of comparison we have included in Table 1 the normal weights of several organs in the Malay race as reported by Sitsen(2) in Java. As was to be expected Sitsen's findings compare favorably with ours. Castor(3) reported slightly smaller heart and kidneys and slightly larger liver and spleen for East Indians. He also reported slightly heavier organs for Burmans.

We have also included in Table 1 the normal weights of organs in Occidental races as given by Jackson.(4) It will be noted that, save for the pancreas, the absolute weights of organs of Occidentals are heavier than those of Filipinos. These findings are verified by the reports of Bean(5, 6) and of Huschke, Frerichs, Birch-Hirschfeld, Thoma, Bollinger, Kalmansohn, Posselt, Prenner, Monneret, as cited by Vierordt.(7)

The pancreas of Filipinos, however, is heavier than that of the Occidental races. This fact was observed by Sitsen in the Malays of Java. Based on Soekaton's(8) hypothesis, Sitsen attributes the large pancreas and salivary glands of Malays to a diet rich in carbohydrates.

TABLE 1.—*Normal weights of the principal visceral organs in adults.*

Organ.	Filipinos (De Leon, Garcia, De Jesus).			Malays (Sitsen). Mean, minimum, and maximum weights.	Occidentals (Jackson). Mean, minimum, and maximum weights.
	Cases.	Mean weight.	Minimum and maximum weights.		
Heart:		g.	g.	g.	g.
Male	620	278.11	230–330	252(220–270)	312
Female	148	237.18	170–310	214(180–250)	256
Spleen:					
Male	614	116.82	50–180		
Female	147	91.84	40–140		
Both					80–300
Liver:					
Male	494	1,211.04	900–1,500	1,290(980–1300)	
Female	125	1,090.64	700–1,500	1,263(750–2180)	
Both					1500(1000–2000)
Pancreas:					
Male	121	105.88	55–155	105	
Female	39	86.23	50–120	99(80–150)	
Both					80(60–100)
Both suprarenals:					
Male	287	15.96	12 20		
Female	84	14.57	10–19		
Both				10(5–20)	
Right suprarenal:					
Male	187	8.36	6–11		
Female	52	7.06	4–10		4–18
Left suprarenal:					
Male	185	9.08	7–11		
Female	52	7.73	5–11		
Both kidneys:					
Male	556	240.13	160–320	210(170–250)	
Female	145	218.86	110–320	202(180–250)	
Right kidney:					
Male	397	117.57	70–170		
Female	89	103.62	50–160		115–150
Left kidney:					
Male	394	124.14	80–170		
Female	89	106.17	50–160		
Thymus:					
Male	69	23.20	12–34		
Female	17	21.00	10–32		
Both				10–20	12.85–25.28

It is also shown in Table 1 that the weights of organs in females are in all cases lighter than those in males. It may be noted further that the left kidney and suprarenal gland are slightly heavier than the corresponding ones of the right side. These observations are in accord with the reports of Jackson.

Tables 2 to 11 represent the average weights of the principal visceral organs of adult Filipinos classified according to age

groups. They reveal a gain in weight for each organ as the individual increases in age up to a certain limit, when the organ appears to reach its maximum weight, after which it exhibits slight retrogression corresponding to advanced age.

TABLE 2.—*Average normal weights of the heart in adult Filipinos.*

Age.	Male.			Female.		
	Cases.	Heart, average weight.	Probable error.	Cases.	Heart, average weight.	Probable error.
Yrs.		*g.*	*g.*		*g.*	*g.*
16–20	110	255.45	±2.96	32	206.72	± 4.43
21–25	124	274.81	±3.91	32	221.81	± 4.14
26–30	101	275.75	±3.19	25	222.64	± 5.46
31–35	64	277.06	±4.24	8	231.88	±12.29
36–40	73	284.81	±4.02	9	244.44	±13.58
41–45	27	287.15	±5.88	7	256.00	± 7.70
46–50	39	291.00	±5.44	7	269.57	±14.10
51–55	26	302.00	± 7.33	2	295 00	
56–60	23	305.83	±6.74	6	299.33	±20.43
61–65	9	312.00	±7.10	2	308.50	
66–70	11	292.00	±7.96	4	287.50	
71–75	2	302.50		1	244.00	
76–80	5	298.80	±5.71	6	286 67	±28.55
81–85	1	297.00		1	257.00	
86 90	2	298.50		4	290.00	
91–over	3	292,00		2	277.50	

TABLE 3.—*Average normal weights of the spleen in adult Filipinos.*

Age.	Male.			Female.		
	Cases.	Spleen, average weight.	Probable error.	Cases.	Spleen, average weight.	Probable error.
Yrs.		*g.*	*g.*		*g.*	*g.*
16–20	104	124.36	±4.02	30	95.00	± 6.20
21–25	119	123.95	±3.37	30	103.37	± 5.23
26–30	98	126.61	±3.66	22	111.64	± 8.85
31 35	65	134.66	±5.36	9	79,78	± 2.98
36–40	67	115.31	±4.54	11	113.91	±14.04
41–45	30	101.23	±5.41	6	95.83	±10.46
46–50	40	112.48	±6.50	9	81.11	± 6.06
51–55	25	84.68	±7.01	8	79.33	
56–60	24	91.33	±6.16	6	80.33	± 7.25
61–65	11	70.82	±7.15	2	50.50	
66–70	17	94.94	±6.93	4	52.00	
71–75	3	90.67		2	56.00	
76–80	6	65.83	±8.91	6	53.00	± 5.19
81–85	2	71.00		1	46.00	
86–90	3	73.33		2	55.00	
91–over	3	54.67		2	46.50	

TABLE 4.—*Average normal weights of the liver in adult Filipinos.*

Age.	Male.			Female.		
	Cases.	Liver, average weight.	Probable error.	Cases.	Liver, average weight.	Probable error.
Yrs.		*g.*	*g.*		*g.*	*g.*
16–20	85	1,196.04	±19.89	30	1,078.93	±35.21
21–25	98	1,218.50	±17.22	24	1,094.79	±25.56
26–30	75	1,213.51	±18.75	17	1,114.88	±38.58
31–35	51	1,270.29	±24.55	6	1,158.83	±19.46
36–40	62	1,222.87	±19.91	9	1,277.89	±61.82
41–45	21	1,233.95	±38.35	5	1,176.40	±88.21
46–50	31	1,145.29	±23.52	6	1,227.00	±65.42
51–55	21	1,305.57	±56.06	3	1,219.67	----------
56–60	16	1,250.94	±43.03	5	929.17	±17.71
61–65	7	1,182.57	±47.71	1	972.00	----------
66–70	13	1,048.08	±50.37	4	1,028.75	----------
71–75	3	1,125.67	----------	2	758.50	----------
76–80	5	1,030.40	±33.88	6	978.67	±68.86
81–85	1	1,170.00	----------	1	786.00	----------
86–90	2	965.00	----------	3	956.33	----------
91–over	3	1,061.00	----------	2	835.50	----------

TABLE 5.—*Average normal weights of the pancreas in adult Filipinos.*

Age.	Male.			Female.		
	Cases.	Pancreas, average weight.	Probable error.	Cases.	Pancreas, average weight.	Probable error.
Yrs.		*g.*	*g.*		*g.*	*g.*
16–20	17	96.00	±3.81	7	91.43	±6.51
21–25	21	100.19	±4.57	7	86.14	±6.72
26–30	27	112.30	±3.10	5	93.80	±4.63
31–35	11	98.91	±4.48	2	91.00	----------
36–40	17	110.65	±4.57	1	105.00	----------
41–45	6	106.00	±7.82	3	112.33	----------
46–50	8	110.75	±5.56	1	85.00	----------
51–55	5	131.80	±7.41	2	92.00	----------
56–60	5	93.40	±9.70	3	73.00	----------
61–65	1	114.00	----------	1	81.00	----------
66–70	1	65.00	----------	2	62.00	----------
71–75	1	94.00	----------	----------	----------	----------
76–80	----------	----------	----------	2	57.50	----------
81–85	----------	----------	----------	1	61.00	----------
86–90	----------	----------	----------	2	79.00	----------
91–over	1	154.00	----------	----------	----------	----------

TABLE 6.—*Average normal weights of both suprarenals in adult Filipinos.*

Age.	Male.			Female.		
	Cases.	Both suprarenals, average weight.	Probable error.	Cases.	Both suprarenals, average weight.	Probable error.
Yrs.		*g.*	*g.*		*g.*	*g.*
16–20	49	15.18	±0.50	15	13.13	±0.65
21–25	53	16.42	±0.47	16	14.75	±1.06
26–30	49	15.06	±0.38	15	15.73	±0.82
31–35	35	16.31	±0.62	5	15.40	±1.37
36–40	28	16.43	±0.64	5	17.20	±1.51
41–45	16	16.75	±0.85	5	13.80	±0.40
46–50	22	16.50	±0.67	3	11.33	
51–55	10	16.20	±0.91	2	12.00	
56–60	9	15.78	±0.81	4	16.50	
61–65	5	15.60	±1.12	2	12.00	
66–70	6	15.33	±0.61	4	16.25	
71–75	1	19.00		1	14.00	
76–80	1	18.00		3	15.00	
81–85				1	10.00	
86–90	2	14.50		2	15.50	
91–over				1	10.00	

TABLE 7.—*Average normal weights of the right suprarenal in adult Filipinos.*

Age.	Male.			Female.		
	Cases.	Right suprarenal, average weight.	Probable error.	Cases.	Right suprarenal, average weight.	Probable error.
Yrs.		*g.*	*g.*		*g.*	*g.*
16–20	30	8.47	±0.30	9	6.11	±0.47
21–25	36	8.50	±0.26	8	8.13	±0.70
26–30	23	8.09	±0.26	8	7.50	±0.34
31–35	22	8.55	±0.35	3	6.33	
36–40	23	8.13	±0.39	3	8.33	
41–45	12	8.42	±0.50	2	5.50	
46–50	15	7.80	±0.38	2	5.50	
51–55	7	8.86	±0.46	1	4.00	
56–60	9	8.44	±0.57	4	8.25	
61–65	3	8.67		1	6.00	
66–70	4	7.75		4	7.50	
71–75				1	7.00	
76–80	1	8.00		2	8.00	
81–85				1	5.00	
86–90	1	7.00		2	7.50	
91–over				1	5.00	

TABLE 8.—*Average normal weights of the left suprarenal in adult Filipinos.*

Age.	Male.			Female.		
	Cases.	Left suprarenal, average weight.	Probable error.	Cases.	Left suprarenal, average weight.	Probable error.
Yrs.		*g.*	*g.*		*g.*	*g.*
16–20	30	9.20	±0.35	9	7.22	±0.49
21–25	36	9.42	±0.28	8	8.00	±0.61
26–30	22	8.64	±0.30	8	7.75	±0.54
31–35	22	9.68	±0.48	3	7.33	
36–40	23	8.89	±0.37	3	10.33	
41–45	12	9.00	±0.57	2	8.50	
46–50	15	8.87	±0.44	2	6.00	
51–55	7	9.57	±0.30	1	5.00	
56–60	8	8.50	±0.48	4	8.25	
61–65	3	9.33		1	6.00	
66–70	4	8.25		4	8.75	
71–75				1	7.00	
76–80	1	10.00		2	8.50	
81–85				1	5.00	
86–90	1	7.00		2	8.00	
91–over				1	5.00	

TABLE 9.—*Average normal weights of both kidneys in adult Filipinos.*

Age.	Male.			Female.		
	Cases.	Both kidneys, average weight.	Probable error.	Cases.	Both kidneys, average weight.	Probable error.
Yrs.		*g.*	*g.*		*g.*	*g.*
16–20	97	234.09	± 3.35	31	214.26	± 5.91
21–25	106	235.51	± 2.57	31	232.87	± 5.77
26–30	89	240.17	± 3.12	21	233.62	± 8.49
31–35	58	245.93	± 4.07	9	214.56	± 8.70
36–40	66	242.44	± 4.09	7	278.43	±13.13
41–45	26	253.65	± 5.84	7	211.57	± 9.69
46–50	34	251.97	± 4.37	11	237.64	±17.56
51–55	23	258.30	± 6.23	2	182.00	
56–60	19	252.37	±11.18	6	191.67	± 6.68
61–65	10	235.90	± 8.04	3	165.33	
66–70	14	193.50	± 5.97	4	189.25	
71–75	3	309.67		2	162.50	
76–80	5	214.40	±19.05	6	159.67	± 5.92
81–85	1	264.00		1	118.00	
86–90	2	200.00		4	206.00	
91–over	3	190.67				

TABLE 10.—*Average normal weights of the right kidney in adult Filipinos.*

Age	Male.			Female.		
	Cases.	Right kidney, average weight.	Probable error.	Cases.	Right kidney, average weight.	Probable error.
Yrs.		*g.*	*g.*		*g.*	*g.*
16–20	60	115.10	±2.33	15	101.13	± 3.58
21–25	83	114.82	±1.67	15	111.27	± 4.68
26–30	52	117.88	±2.55	13	116.08	± 4.94
31–35	42	120 57	±2.53	3	97.67	
36–40	54	116.50	±2.44	4	123.50	
41–45	18	122.72	±3.78	4	104.50	
46–50	25	120.24	±3.53	8	119.63	±10.36
51–55	19	133.32	±6.94	2	91.00	
56–60	17	121.47	±5 88	6	95.33	± 3.68
61–65	6	125.00	±5.73	3	84.67	
66–70	10	86.30	±2 55	4	91.25	
71–75	2	167.50		2	82.50	
76–80	4	112 50		6	78.33	± 3.41
81–85	1	132.00		1	59.00	
86–90	2	90.00		3	99.33	
91–over	2	116.50				

TABLE 11.—*Average normal weights of the left kidney in adult Filipinos.*

Age.	Male.			Female.		
	Cases.	Left kidney, average weight.	Probable error.	Cases.	Left kidney, average weight.	Probable error.
Yrs.		*g.*	*g.*		*g.*	*g.*
16–20	60	120.62	±2.38	15	104.47	± 4.03
21–25	83	122.84	±1.55	15	113.07	± 4.30
26–30	53	124.21	±2.32	13	119.54	± 6.30
31–35	42	181.21	±2.69	3	103.00	
36–40	54	122.83	±2.32	4	130.50	
41–45	18	130.44	±3.66	4	117.75	
46–50	22	124.18	±4.78	8	113.50	±15.30
51–55	18	131.89	±3.76	2	91.00	
56–60	17	129.41	±6.85	6	96.33	± 3.61
61–65	6	127.00	±5.26	3	80.67	
66–70	10	94.20	±3.40	4	98.00	
71–75	2	167.50		2	80.00	
76–80	4	116.00		6	81.33	± 2.78
81–85	1	132.00		1	59.00	
86–90	2	110.00		3	107.00	
91–over	2	121.00				

Thus, the heart increases in weight until the age of 65 years or later, after which it decreases in weight. The spleen grows heavier up to the age of about 35 years, after which it diminishes progressively in weight, until at 90 years it is only about half of its weight at 35.

The liver becomes heavier up to the age of about 55 years, after which it diminishes in weight, until at 90 years it is only about three-fourths of its maximum weight. The kidneys increase slowly in weight up to 40 or 60 years, after which they gradually decrease in weight.

Similar findings have been reported by Bean,(9) and by Thoma, Muller, and Geist, cited by Vierordt.(10)

BIBLIOGRAPHY

1. JESUS, P. I. DE, W. DE LEON, and P. ANZURES. Normal weights of visceral organs in Filipino children. Philip. Journ. Sci. 52 (1933) 99–109.
2. SITSEN, A. E. The normal weight of several organs with Malay race. Mededeelingen van den Dienst der Volksgezondheid in Nederlandsch-Indie. Foreign ed., Part III (1927) 490–499.
3. CASTOR, R. H. Weights of organs. Journ. Trop. Med. and Hyg. 15 (1912) 17–24.
4. JACKSON, C. M. Morris' Human Anatomy, 8th ed. P. Blakiston's Son & Co., Philadelphia (1925).
5. BEAN, R. B., and W. BAKER. Some racial characteristics of the liver weight in man. Am. Journ. Phys. Anthropology 2 (1919) 167–173.
6. BEAN, R. B., and W. BAKER. Some racial characteristics of the weight of the heart and kidneys. Am. Journ. Phys. Anthropology 2 (1919) 265–274.
7. VIERORDT, H. Anatomische Physiologische und Physikalische Daten und Tabellen. Gustav Fischer, Jena (1906) 35.
8. SOEKATON REKSOWIDJOJO, R. Mededeelingen van den B. G. D. 2 (1923).
9. BEAN, R. B. Notes on the weight of some vital organs—their development, variability and relation to disease—a summary. Virginia Med. Month. 52 (1926) 692–697.
10. VIERORDT, H. Op. cit. 40.

NORMAL WEIGHTS OF VISCERAL ORGANS IN FILIPINOS IN RELATION TO LENGTH AND BODY WEIGHT

By P. I. DE JESUS, W. DE LEON, and J. M. RAMOS

Of the School of Hygiene and Public Health, University of the Philippines Manila

TWO TEXT FIGURES

This study is based on 1,106 necropsies of accident cases including 855 males and 251 females, selected from more than 12,000 necropsies performed in the Department of Pathology and Bacteriology and the Department of Legal Medicine, University of the Philippines. We have recorded in Tables 1 and 2 the absolute average weights of normal visceral organs of male and female Filipinos classified in relation to crown-heel body length.

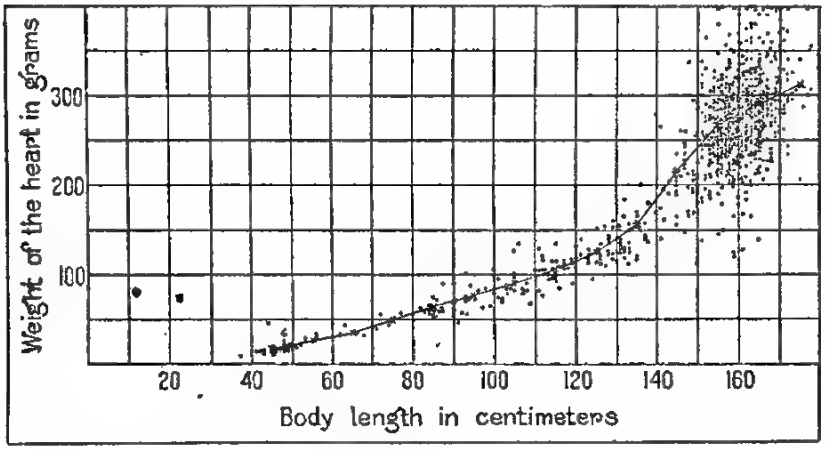


FIG. 1. The distribution of individual observations of the weight of the heart plotted against crown-heel body length.

Analysis of the tables shows that the weight of a visceral organ tends to increase with increasing body length, although the gain in weight is not equal for all length intervals. It is interesting to note from the study of these tables that for individuals of equal lengths there is generally no marked difference in the weights of organs between males and females.

In figure 1 the weight of the heart is plotted against the crown-heel body length. The dots represent individual ob-

servations. The crosses represent the averages of these observations at 10-cm intervals of body length. The curve shown by the solid line represents the point-to-point curve of the averages at 10-cm intervals from 45 cm to 175 cm, inclusive.

With the exception of the suprarenal glands, the other organs exhibit the same tendency of curve as the heart for both males and females. The suprarenal glands show decrease instead of increase in weight, among individuals (children) between 40 and 70 cm. Beyond 70 cm they present a type of curve similar to that shown by the other organs.

In Table 3 the proportion of organ weight to the entire body length is presented, expressed in grams per meter length.

Tables 4 and 5 show the weights of visceral organs of male and female Filipinos classified in relation to increasing body

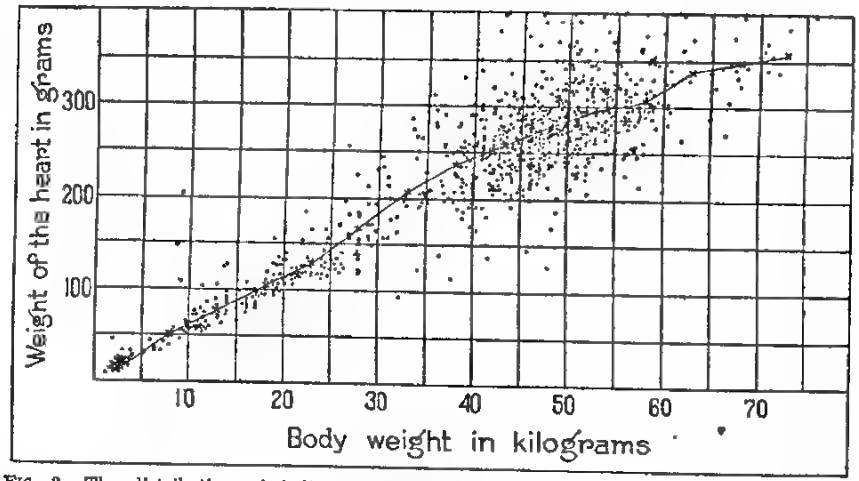


FIG. 2. The distribution of individual observations of the weight of the heart against body weight.

weight. From these tables it will be noted that for equal weights, the organs of females are slightly lighter than the corresponding organs of males. Furthermore, it will be observed that in general the weight of an organ increases with increasing body weight, although the gain in weight is not equal for all groups.

Fig. 2 shows the graphical representation of the weight of the heart plotted against body weight. The dots represent individual observations. The crosses represent the averages of these observations at 5-kg intervals of body weight. The solid line represents the point-to-point curve of the averages from 3.5 kg to 78 kg of body weight, inclusive.

TABLE 1.—*Weights of the principal visceral organs in relation to increasing body length (male).*

Body length.	Heart.		Spleen.		Liver.		Pancreas.		Suprarenals (both).		Kidneys (both).	
	Cases.	Average weight.	Cases.	Average weight.	Cases.	Average weight.	Cases.	Average weight.	Cases.	Average weight.	Cases.	Average weight.
cm.		*g.*		*g.*		*g.*		*g.*		*g.*		*g.*
45	31	17.87±0.84	30	7.47±0.46	30	105.67± 4.01	8	2.75±0.23	24	7.88±0 28	28	25.14±0.71
55	6	26.33±1.57	6	14.50±1.59	6	153.00± 9.88	2	5.50	4	9.50	6	36.67±1.10
65	5	35.00±1.40	5	28.60±1.46	4	219.75	1	15.00	2	6.50	3	56.00
75	5	50.20±2.17	5	45.60±3.65	5	354.60±20.63	1	17.00	2	5.50	5	60.20±1.78
85	23	64.48±1.40	21	48.62±2.32	20	424.05±10.58	4	28.75	11	7 64±0.57	17	76.35±2.74
95	16	76.25±2.73	15	44.33±1.88	15	494.87±26.49	1	18.00	6	7.00± 0 65	14	92.29±2.87
105	21	89.76±2.41	21	50.10±2.19	22	600.82±27.53	5	36.00±2.95	10	8.40±0.70	20	104.70±6.01
115	36	106.44±3.55	34	65.41±3.88	32	661.41±14.94	12	51.17±3.21	19	9.37±0.44	29	116.66±5.52
125	30	127.73± 1.79	29	72.45±2.54	30	783.80±14.34	5	55.20±2.30	13	11.00±0.52	26	154.15±5.78
135	34	156.47±4.93	33	80.33±4.72	32	899.31±22.57	10	57.10±2.31	19	9.32±0.56	29	157.59±3 29
145	56	216.11±3.82	61	98.07±5.05	48	1,026.25±17.53	12	92.00±5.74	29	13.10±0.51	49	196.41±5.11
155	292	267.49±1.94	291	116.41±2.40	270	1,212.44± 9.89	56	103.16±2.45	147	15 86±0.29	270	231.46±1.72
165	265	292.07±2.37	262	123.67±2.74	238	1,256.14±11.53	57	108.60±2.39	124	15.69±0.27	243	249.34±2.12
175	35	312.60±5.84	34	153.18±7.66	30	1,444.20±38.36	3	104.67	7	18.14±0.74	33	287.06±7.72

TABLE 2.—*Weights of the principal visceral organs in relation to increasing body length (female).*

Body length.	Heart.		Spleen.		Liver.		Pancreas.		Suprarenals (both).		Kidneys (both).	
	Cases.	Average weight.	Cases.	Average weight.	Cases.	Average weight.	Cases.	Average weight.	Cases.	Average weight.	Cases.	Average weight.
cm.		*g.*		*g.*		*g.*		*g.*		*g.*		*g.*
45	14	18.43± 0.56	13	9.61±0.76	12	138.17± 6.14	5	3.60±0.56	14	10.50±0.64	14	27.29±1.62
55	6	21.33± 1.58	5	13.60±1.55	4	151.25			2	11.50	4	26.50
65	6	37.00± 2.67	5	27.60±1.43	5	206.20± 7.68	1	19.00	5	5.60±0.95	2	51.00
75	11	50.82± 1.22	11	34.82±1.90	9	337.89± 8.79	2	21.00	6	6.50±0.56	5	59.83±1.54
85	8	57.38± 1.87	8	40.00±2.10	8	417.88±30.94	2	20.50	3	7.33	5	78.00±2.45
95	17	75.76± 2.51	18	44.78±2.27	17	491.29±30.29	4	24.75	8	5.63±0.58	16	86.69±1.72
105	8	90.12± 2.82	8	47.50±1.98	8	525.00±24.78			4	7.75	7	96.00±3.68
115	8	90.00± 6.35	8	37.87±3.77	7	577.71±26.94	5	46.00±2.85	4	8.25	7	103.71±4.96
125	5	122.60± 5.33	5	80.20±9.86	5	702.60±43.61	1	50.00	2	11.00	5	144.20±7.42
135	17	182.76± 7.87	18	77.83±6.32	18	821.33±34.30	9	66.33±3.15	17	13.47±0.69	12	166.89±5.89
145	76	220.36± 3.60	69	85.96±3.10	74	1,053.31±15.47	12	81.67±3.45	38	12.72±0.43	69	206.57±3.73
155	69	260.14± 5.11	66	103.95±5.44	63	1,174.19±20.22	19	93.26±4.52	29	16.76±0.66	58	231.78±4.66
165	6	260.50±13.76	5	114.60±9.07	7	1,215.43±60.89			2	16.50	4	219.25

TABLE 3.—*Weights in grams of the principal visceral organs per meter body-length.*

Body length.	Male.						Female.					
	Heart.	Spleen.	Liver.	Pancreas.	Supra-renals (both).	Kidneys (both).	Heart.	Spleen.	Liver.	Pancreas.	Supra-renals (both).	Kidneys (both).
cm.												
45	39.7	16.6	234.8	6.1	17.5	55.9	41.0	21.4	307.0	8.0	23.3	60.6
55	47.9	26.4	278.2	10.0	17.3	66.7	38.8	24.7	275.0	----------	20.9	48.2
65	53.8	44.0	338.1	23.1	10.0	86.2	56.9	42.5	317.2	29.2	10.2	78.5
75	66.9	60.8	472.8	22.7	7.3	80.3	67.8	46.4	450.5	28.0	8.7	79.8
85	75.9	57.2	498.9	33.8	9.0	89.8	67.5	47.1	491.6	24.1	8.6	91.8
95	80.3	46.7	520.9	18.9	7.4	97.1	79.7	47.1	517.1	26.1	5.9	91.3
105	85.5	47.7	572.2	34.3	8.0	99.7	85.8	45.2	500.0	----------	7.4	91.4
115	92.6	56.9	575.1	44.5	8.1	101.4	78.3	32.9	502.4	40.0	7.2	90.2
125	102.2	58.0	627.0	44.2	8.8	123.3	98.1	64.2	562.1	40.0	8.8	115.4
135	115.9	59.5	666.2	42.3	6.9	116.7	135.4	57.7	608.4	49.1	10.0	123.6
145	149.0	67.6	707.8	63.4	9.0	135.5	163.2	59.3	726.4	56.3	8.8	142.5
155	172.6	75.1	782.2	66.6	10.2	149.3	167.8	67.1	757.5	60.2	10.8	149.5
165	177.0	75.0	761.3	65.8	9.5	151.1	157.9	69.5	736.6	----------	10.0	132.9
175	173.6	87.5	825.3	59.8	10.4	164.0	----------	----------	----------	----------	----------	----------

TABLE 4.—*Weights of the principal visceral organs in relation to increasing body weight (male).*

Body weight.	Heart.		Spleen.		Liver.		Pancreas.		Suprarenals (both).		Kidneys (both).	
	Cases.	Average weight.	Cases.	Average weight.	Cases.	Average weight.	Cases.	Average weight.	Cases.	Average weight.	Cases.	Average weight.
kg.		*g.*		*g.*		*g.*		*g.*		*g.*		*g.*
3.5	38	19.50±1.17	38	9.76± 0.91	37	115.51± 4.54	10	3.30±0.33	30	8.03±0.31	34	26.62± 0.86
8	18	50.83±3.31	18	39.11± 2.73	15	351.67±13.07	5	21.40±1.74	9	6.33±0.40	15	63.60± 2.41
13	40	76.65±1.90	38	50.39± 2.13	40	489.45±12 35	5	32.20±1.57	17	7.88±0.52	36	90.58± 3.09
18	49	104.59±2.72	46	59.74± 2.12	44	641.23±15.39	11	48.27±3.49	27	9.26±0.46	45	111.47± 3.00
23	39	128.97±2.76	39	68.92± 2.80	38	782.79±13.60	12	55.92±1.77	21	10.33±0.51	34	155.00± 3.86
28	34	165.88±4.12	28	79.96± 4.30	34	962.68±23.10	9	60.44±3.19	18	10.94±0.61	34	179.41± 3.76
33	31	206.94±5.56	29	83.69± 4.42	25	1,034.40±29.06	9	66.33±2.30	20	13.90±0.54	28	199.61± 6.33
38	66	236.03±3.33	63	98.13± 5.02	58	1,109.33±19.38	14	98.14±4.23	27	15.78±0.79	59	225.10± 4.93
43	132	257.82±2.43	136	108.35± 3.05	118	1,127.35±12.50	29	95.38±4.21	68	15.15±0.42	114	225.51± 2.82
48	165	279.19±2.68	157	115.35± 2.89	151	1,191.01±13.21	27	106.52±2.18	80	15.86±0.36	146	231.47± 2.19
53	133	298.92±2.68	129	135.95± 3.98	120	1,266.40±13.90	27	115.26±2.73	61	16.62±0.41	125	251.04± 2.95
58	70	305.11±3.58	70	138.06± 6.22	65	1,375.52±21.28	15	125.20±3.48	33	15.48±0.55	61	269.70± 4.60
63	17	338.47±8.92	17	161.23±15.13	15	1,528.13±37.56	3	114.00	4	17.75	16	281.19± 8.93
68	12	347.92±8.27	12	140.33±11.88	9	1,545.22±63.04	1	127.00	6	15.50±0.79	10	301.30± 9.78
73	6	357.83±4.48	6	124.83± 8.85	5	1,378.60±39.02			2	18.00	5	279.00±11.62
78	1	413.00	1	87.00	1	1,495.00	1	170.00	1	18.00	1	272.00.

TABLE 5.—*Weights of the principal visceral organs in relation to increasing body weight (female).*

Body weight.	Heart.		Spleen.		Liver.		Pancreas.		Suprarenals (both).		Kidneys (both).	
	Cases.	Average weight.	Cases.	Average weight.	Cases.	Average weight.	Cases.	Average weight.	Cases.	Average weight.	Cases.	Average weight.
kg.		*g.*		*g.*		*g.*		*g.*		*g.*		*g.*
3.5	22	19.73± 0.56	20	11.25± 0.83	18	148.39± 5.87	5	8.60±0.56	18	10.06±0.60	19	27.53± 1.33
8	23	52.74± 1.85	22	35.41± 1.32	21	869.33±23.23	5	20.60±1.22	18	6.69±0.42	12	70.33± 3.83
13	23	76.65± 3.35	25	47.28± 1.88	21	507.52±27.90	4	24.50	10	6.10±0.53	20	85.75± 1.49
18	11	95.91± 5.40	12	45.25± 3.16	11	537.91±17.75	4	43.25	4	7.25	10	105.00± 3.86
23	7	120.00± 8.75	6	62.17± 5.30	7	748.85±41.60	2	53.50	6	9.83±0.93	6	146.00± 6.31
28	13	195.08± 7.68	14	91.28± 7.81	12	875.67±61.48	6	60.00±4.47	8	13.00±0.98	12	167.00± 5.78
33	22	220.59± 8.26	24	67.62± 5.41	23	889.39±23.66	6	80.33±4.40	11	13.64±0.57	20	185.80± 6.01
38	50	225.84± 4.09	46	94.02± 4.32	47	1,081.62±17.31	9	81.67±1.75	27	13.26±0.51	47	215.64± 4.51
43	33	237.42± 6.78	32	98.41± 6.61	33	1,120.12±29.83	5	80.80±5.98	14	13.29±0.57	30	215.53± 6.04
48	21	239.90± 7.67	21	106.00± 7.56	20	1,160.25±26.08	10	96.00±5.71	10	19.90±1.15	20	236.25± 6.70
53	17	283.88±11.00	17	125.76±12.91	18	1,312.44±42.35	2	135.00	10	16.40±1.17	17	244.59±10.56
58	4	231.25	4	95.75	3	1,206.33					3	231.67
63	3	283.67	2	81.00	2	1,141.00			1	12.00	2	222.50
68	2	274.50	2	79.00	2	1,326 00			1	13.00	3	217.67
78											1	215.00
78	1	335.00	1	180.00								

TABLE 6.—*Percentage weights of the principal visceral organs in relation to the body weight.*

Body weight.	Male.						Female.					
	Heart.	Spleen.	Liver.	Pancreas.	Suprarenals (both).	Kidneys (both).	Heart.	Spleen.	Liver.	Pancreas.	Suprarenals (both).	Kidneys (both).
kg.												
3.5	0.56	0.28	3.30	0.09	0.229	0.76	0.56	0.32	4.24	0.10	0.287	0.79
8	0.64	0.49	4.40	0.27	0.079	0.79	0.66	0.44	4.62	0.26	0.084	0.88
13	0.59	0.39	3.76	0.25	0.061	0.70	0.59	0.36	3.90	0.19	0.047	0.66
18	0.58	0.33	3.56	0.27	0.051	0.62	0.53	0.25	2.99	0.24	0.040	0.58
23	0.56	0.30	3.40	0.24	0.045	0.67	0.52	0.27	3.26	0.23	0.043	0.63
28	0.59	0.29	3.44	0.22	0.039	0.64	0.70	0.33	3.13	0.21	0.046	0.60
33	0.63	0.25	3.13	0.20	0.042	0.60	0.67	0.20	2.70	0.24	0.041	0.56
38	0.62	0.26	2.92	0.26	0.042	0.59	0.59	0.25	2.85	0.21	0.035	0.57
43	0.60	0.25	2.62	0.22	0.036	0.52	0.55	0.23	2.60	0.19	0.031	0.50
48	0.58	0.24	2.48	0.22	0.033	0.48	0.50	0.22	2.42	0.20	0.041	0.49
53	0.56	0.26	2.39	0.22	0.031	0.47	0.54	0.24	2.48	0.25	0.031	0.46
58	0.53	0.24	2.37	0.22	0.027	0.47	0.40	0.17	2.08	----------	----------	0.40
63	0.54	0.26	2.43	0.18	0.028	0.45	0.45	0.13	1.81	----------	0.019	0.35
68	0.51	0.21	2.27	0.19	0.023	0.44	0.40	0.12	1.95	----------	0.019	0.32
73	0.49	0.17	1.89	----------	0.025	0.38	----------	----------	----------	----------	----------	0.29
78	0.53	0.11	1.92	0.22	0.023	0.35	0.43	0.23	----------	----------	----------	----------
Mean....	0.58	0.27	2.82	0.22	0.051	0.55	0.58	0.28	3.10	0.21	0.076	0.58

The other organs exhibit the same tendency of curve for both males and females. An exception is found in the suprarenal glands, which recorded a reduction in weight for individuals with body weights between 2 and 10 kg, but beyond 10 kg the suprarenals follow the type of curve shown by the other organs.

Table 6 gives the proportion of organ weight to the weight of the entire body, expressed in percentage of the total body weight.

279758—4

ILLUSTRATIONS

TEXT FIGURES

NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XV[1]

By CHARLES P. ALEXANDER
Of Amherst, Massachusetts

TWO PLATES

The very interesting Tipulidæ discussed herein have been derived from a variety of sources. The unusually valuable collections from eastern Siberia, belonging to the zoölogical museum of the Russian Academy of Sciences, Leningrad, were included in rich series of these flies submitted to me for determination by Drs. Theodore Pleske and A. von Stackelberg, to whom I express my sincere thanks and appreciation for the opportunity of extending our knowledge of the Tipulidæ to the northward in eastern Asia. All types resulting from these materials are in the zoölogical museum of the Russian Academy of Sciences. The material from China is chiefly from the rich Graham collections in the United States National Museum, with other species in my own collection, collected by Messrs. Franck and Kellogg. The Japanese Tipulidæ were collected by Messrs. Esaki, Kariya, and Nakamura, the Esaki material being returned to Doctor Esaki for preservation in the entomological collection of Fukuoka Imperial University, the other specimens in my own collection through the continued kindly interest of the collectors.

TIPULINÆ

TIPULA (ACUTIPULA) BIPENICILLATA Alexander. Plate 2, fig. 25.

Tipula bipenicillata ALEXANDER, Philip. Journ. Sci. 24 (1924) 603–604.

The types were from Saghalien Island, collected by Esaki. Two additional males were taken at Ozenuma, Fukushima, Honshiu, Japan, July 28 and 29, 1931, by Nakamura, greatly extending the range of the fly.

The peculiar conformation of the inner dististyle (Plate 2, fig. 25, *id*) of the male hypopygium renders the fly easily recognizable. The rostral portion of the style is blackened and

[1] Contribution from the entomological laboratory, Massachusetts State College.

provided with small setæ; in the notch between this projection and the apical lobe extends a long slender pale rod. The outer dististyle (Plate 2, fig. 25, *od*) is broad, dilated at midlength, with sparse setæ that are chiefly marginal in distribution, as is common in the subgenus. Eighth sternite across caudal portion nearly straight or only slightly emarginate, with two widely separated groups or pencils of setæ.

TIPULA (ACUTIPULA) DESIDIOSA sp. nov. Plate 2, fig. 26.

General coloration of mesonotum gray, the præscutum with an intermediate pair of more grayish brown stripes; pleura light yellow, the anepisternum and ventral sternopleurite light gray; legs black, only the femoral bases narrowly brightened; wings grayish, almost immaculate, the usual dark spot in cell Cu very faintly indicated; bases of outer radial cells darkened; a conspicuous obliterative streak before cord; median lobe of ninth tergite of male hypopygium weakly notched at apex, set with abundant black spines.

Male.—Length, about 16 millimeters; wing, 17.5.

Frontal prolongation of head dark dorsally, somewhat brighter laterally; nasus elongate; palpi with basal segment dark brown, the succeeding segments much paler, the distal portion of last segment broadly dark brown. Antennæ with scape and pedicel light yellow; flagellum black, the basal portion of the first segment paler; verticils elongate. Head gray, with extremely vague indications of a darker median vitta.

Pronotum ocher-yellow. Mesonotal præscutum light gray, with an intermediate pair of more grayish brown stripes, in addition to paler brown lateral stripes; scutum light gray, the lateral portions of the lobes marked with grayish brown, the areas of the two lobes thus being unusually widely separated. Pleura light yellow, the anepisternum and ventral sternopleurite light gray; dorsopleural region buffy yellow. Halteres with stem dark brown, the base narrowly light yellow, the knob paler apically. Legs with the fore coxæ gray pruinose, yellow apically; remaining coxæ light yellow; trochanters yellow; legs black, only the very narrow femoral bases obscure yellow, broadest on the forelegs where about the basal fifth is brightened, on the hind legs the bright color almost obsolete. Wings with a grayish tinge, the stigma brown; a conspicuous whitish obliterative streak before cord, extending from before stigma into the base of cell M_3; bases of radial cells beyond cord, together with outer portion of cell M, a little infumed; a vague indication of a brownish cloud before midlength of cell Cu; veins

brown. Venation: Rs a trifle longer than m-cu; M_{3+4} and basal section of M_3 subequal.

Basal abdominal tergites yellow, narrowly and interruptedly trivittate with dark brown, the lateral margins of the segments broadly buffy, on fifth and succeeding segments, the color passing into dark brownish gray; hypopygium dark; basal sternites yellow, the remainder dark. Male hypopygium with the median lobe of tergite, 9*t*, long and slender, very weakly notched at apex, set with abundant black spicules. Outer dististyle, *od*, narrow at base, strongly curved and expanded outwardly, the surface with microscopic pale setæ only. Inner dististyle, *id*, with two beaklike portions, the outer ending in a triangular point and provided with numerous strong setæ; apex of style broadly and obtusely rounded, with a dense group of long setæ. Eighth sternite slightly produced and compressed medially.

Habitat.—China-Tibet border.

Holotype, male, Yin-Kuan-Tsai, altitude 13,000 to 15,000 feet, July 25, 1930 (*Graham*).

Tipula (*Acutipula*) *desidiosa* is clearly different from the other regional species of the subgenus. At first sight the species appears to fall in the group of clear-winged species allied to *munda*, but there is a distinct though very faint wing pattern, including the characteristic dark cloud in cell Cu. The nearest ally appears to be *T.* (*A.*) *kuzuensis* Alexander (Japan), which is distinct in the details of the male hypopygium, especially of the dististyles, the outer bearing a brush of long coarse setæ on margin near base.

TIPULA (ACUTIPULA) ONCERODES sp. nov. Plate 1, fig. 1; Plate 2, fig. 27.

Size large (wing over 25 millimeters); general coloration of mesonotal præscutum obscure yellow, with four brown stripes; antennal flagellum bicolorous; thoracic pleura yellow; wings tinged with brown, with a conspicuous whitish obliterative streak before cord; no dark spot in cell Cu; abdominal tergites obscure yellow, with a conspicuous sublateral brown stripe, the outer segments uniformly blackened; median lobe of tergite of male hypopygium simple.

Male.—Length, 25 to 27 millimeters; wing, 26 to 28; hind leg (type), femur, 20; tibia, 24.5; basitarsus, 32.

Frontal prolongation of head dark brown, narrowly reddish brown sublaterally above; nasus elongate; palpi brownish black. Antennæ relatively short, only a little longer than the palpi; scape obscure brownish yellow, weakly pruinose above; pedicel obscure yellow; flagellum bicolorous, the basal enlargements

brownish black, the remainder brownish yellow; verticils elongate. Head dark grayish brown; anterior vertex relatively narrow, about twice the diameter of scape.

Posterior pronotum dark brown. Mesonotal præscutum obscure yellow, with four dark brown stripes, the intermediate pair widely separated on more than the anterior half, converging behind, confluent at suture; posterior sclerites of mesonotum chiefly dark brown; dorsal pleurotergite restrictedly darkened, the remainder light yellow. Pleura entirely light yellow. Halteres dark brown, the extreme base of stem yellowish, the apex of knob whitish. Legs with the coxæ and trochanters light yellow; femora brownish yellow, the tips narrowly blackened, the amount nearly equal on all legs, being a trifle less on posterior femora; tibiæ and tarsi brownish black. Wings (Plate 1, fig. 1) tinged with brownish, especially in the outer radial field; stigma and costal region darker brown than the ground; a conspicuous whitish obliterative streak before cord, crossing cell 1st M_2 into base of M_3; vein Cu at junction of m-cu vaguely suffused with brown; no dark spot in cell Cu; veins brown. Venation: Rs and m-cu subequal, the latter a short distance before the fork of M_{3+4}; vein R_{4+5} deflected caudad on outer portion, ending just behind the wing tip; basal section of M_{3+4} subequal to or shorter than the basal section of M_3.

Abdominal tergites obscure yellow, with a conspicuous sublateral brown stripe that is very narrowly broken by pale at caudal margins of segments; on fifth and succeeding tergites, the segments almost uniformly blackened; caudal margins of tergites very narrowly, lateral margins a little more broadly pale; sternites yellow, the outer segments dark brown; outer dististyle pale yellow. Male hypopygium with the median lobe of tergite broad-based, narrowed to the simple apex, which is set with abundant small black spicules. Outer dististyle (Plate 2, fig. 27, *od*) relatively narrow, a little dilated at midlength, the apex truncated. Inner dististyle, *id*, with a small dark-colored fingerlike lobe on outer margin at near two-thirds the length. Eighth sternite with a small U-shaped median incision that is bordered by weak setæ that are not arranged in brushes or pencils.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, altitude, 3,500 feet, August 16, 1931 (*Franck*). Paratopotypes, males, August 14 to 16, 1931.

Tipula (*Acutipula*) *oncerodes* is allied to species such as *T.* (*A.*) *bipenicillata* Alexander, *T.* (*A.*) *biramosa* Alexander, and

T. (*A.*) *tokionis* Alexander, having the median lobe of the ninth tergite of the male hypopygium simple, and with the wings nearly immaculate, lacking any dark spot in cell Cu. The species is readily told from all such allied forms by its large size and structure of the male hypopygium, especially of the inner dististyle and the armature of the eighth sternite.

TIPULA (ACUTIPULA) LATIFASCIATA sp. nov. Plate 1, fig. 2.

Allied to *atuntzuensis;* general coloration olive-gray, the præscutum with four brown stripes; antennal flagellum almost uniformly blackish, scape and pedicel yellow; femora yellow, the tips narrowly and abruptly black; wings with the ground color brownish yellow, the radial cells beyond cord darker; dark spot in cell Cu conspicuous, preceded and followed by light yellow areas; a similar yellow spot at two-thirds the length of cell M; obliterative area before cord very wide, sending a narrower line across the bases of the outer medial cells; abdominal tergites chiefly pale brown, narrowly trivittate with darker; outer segments more uniformly darkened.

Female.—Length, 20 to 24 millimeters; wing, 18 to 20.

Frontal prolongation of head yellow dorsally, infuscated laterally beneath; nasus and palpi brownish black. Antennæ with the scape and pedicel yellow; flagellum almost uniformly darkened, the basal enlargements black, the remainder dull brownish black; verticils elongate. Head olive-gray.

Pronotum olive-gray. Mesonotum olive-gray, the præscutum with four brown stripes, the intermediate pair not attaining the suture and, in cases, a little more intensely colored along their mesal edges; each scutal lobe with a single darkened area; scutellum without dark median vitta. Pleura olive-gray, the ventral sternopleurite and most of anepisternum darker gray. Halteres blackened. Legs with the coxæ gray; trochanters yellow; femora yellow, the tips narrowly but conspicuously black, the amount including the distal fifth (forelegs) to sixth (hind legs); tibiæ brownish yellow, the tips narrowly dark brown; basal two segments of tarsi chiefly pale, narrowly tipped with black, the remaining segments uniformly darkened. Wings (Plate 1, fig. 2) with a strong brownish yellow suffusion, the stigma and spot in cell Cu darker brown; region beyond the obliterative band, including bases of outer radial cells and the outer half of cell 1st M_2 somewhat more infumed; m-cu narrowly clouded with darker; areas in outer half of cell M and in cell Cu on either side of the dark spot clear yellow; an unusually

broad obliterative streak before cord, extending into bases of cells M_3 and M_4, thence continued outwardly to include the subbasal portions of cells M_1, 2d M_2, and a small contiguous spot in outer half of cell R_5; veins yellow, abruptly dark brown in the darkened area beyond the obliterative band, including vein M_{1+2} beyond the basal section, bases of M_1 and M_2, m, and the narrow adjoining portions of vein M_3; m-cu slightly less darkened. Venation: Rs a little exceeding m-cu; m a little shorter than the petiole of cell M_1.

Abdominal tergites chiefly pale brown, the basal segments more brightened, brownish yellow; a narrow blackened median vitta along tergites, together with somewhat broader sublateral stripes; lateral margins narrowly pale; basal sternites chiefly yellow, the outer segments passing into darker. Cerci long and slender.

Habitat.—China-Tibet border.

Holotype, female, Yu-Long-Gong, altitude 14,000 feet, August 14, 1930 (*Graham*). Paratypes, 1 female, Tatsienlu, altitude 8,000 to 9,000 feet, August 16, 1930; 1 female, near Yien Long Shien, altitude 13,000 to 15,000 feet, August 3 to 6, 1930.

The nearest ally of the present fly is *Tipula* (*Acutipula*) *atuntzuensis* Edwards (Yunnan), which differs conspicuously in the coloration of the legs, the femora being extensively and gradually infuscated on outer portions, not narrowly and abruptly blackened. The dark spot in cell Cu is broader in *atuntzuensis* while the pale obliterative band is narrower.

TIPULA (INDOTIPULA) SUBYAMATA sp. nov. Plate 2, figs. 28 and 29.

Male.—Length, 13 to 14 millimeters; wing, 15.5 to 17.5.

Female.—Length, about 21 millimeters; wing, 19.

Generally similar and closely related to *yamata* Alexander (Japan), differing especially in the details of structure of the male hypopygium.

Male hypopygium with the lobes of the ninth tergite (Plate 2, fig. 28, 9*t*) much broader and heavily blackened throughout. Outer dististyle, *od*, narrow, the tip obtusely rounded, the outer margin with setæ that are relatively much shorter and more scattered than in *yamata*. Inner dististyle, *id*, narrow, the outer margin with eighteen modified flattened setæ. The details of the hypopygium of *yamata* (Plate 2, fig. 29, 9*t*, *od*, *id*) are shown for comparison. Here the modified setæ of the inner dististyle total twenty-four in number.

Habitat.—China (Szechwan).

Holotype, male, Chunking, altitude 1,000 to 2,000 feet, May 6 to 27, 1930 (*Graham*). Allotopotype, female. Paratopotype, male.

TIPULA AMYTIS sp. nov. Plate 1, fig. 3.

General coloration gray, the præscutum with well-defined intermediate brown stripes, the lateral stripes diffuse; an additional capillary median brown vitta on præscutum; antennal scape dark brown, pedicel light yellow; apices of knobs of halteres obscure yellow; femora yellow, the tips black; wings pale brown, the stigma and a confluent seam on anterior cord dark brown; conspicuous whitish areas on disk, including an incomplete fascia beyond cord and stigma; basal abdominal tergites yellow, with a broad sublateral black stripe; terminal segments black.

Female.—Length, about 22 millimeters; wing, 21.

Frontal prolongation of head relatively long, gray pruinose, especially above; nasus distinct; palpi black. Antennæ with scape dark brown, the pedicel abruptly light yellow; flagellum broken. Head light gray, the center of vertex slightly infumed.

Mesonotal præscutum gray, with four brown stripes, the intermediate pair widely divided by a line of the ground color that is further split on cephalic portion by a capillary brown vitta; lateral stripes much paler and very broad and diffuse, reaching the lateral border of sclerite; posterior sclerites of mesonotum gray, variegated with darker areas. Pleura gray, the anepisternum and ventral sternopleurite somewhat darker gray; dorsopleural region more buffy brown. Halteres yellow, the basal half of knob more infuscated. Legs with the coxæ grayish pruinose; trochanters brownish yellow; femora yellow, tipped with black; remainder of legs broken. Wings (Plate 1, fig. 3) with the ground color pale brown, the prearcular and costal regions more yellowish; disk variegated by conspicuous whitish areas; stigma and a broad confluent seam on anterior cord dark brown; a similar colored, elongate-oval area at origin of Rs; the whitish areas include the basal third of cell M, confluent with subbasal areas in cells Cu and 1st A; a large area at two-thirds the length of cell M; small markings before and beyond origin of Rs; a conspicuous, incomplete, white crossband beyond cord, extending from costa through cell 1st M_2; wing tip uniformly darkened; darkened areas adjoining vein Cu more intense and deeply colored; veins brown, the obliterative areas conspicuous. Venation: R_{1+2} entire; Rs long, approximately twice m-cu; m shorter than petiole of cell M_1; cell 1st M_2 narrowed outwardly.

Abdominal tergites one to five yellow, beyond the second becoming more obscure; a broad sublateral black stripe, bordered externally by a light gray margin; segments six to nine black, the lateral pale borders very narrow and finally becoming obsolete. Ovipositor with cerci straight, the margins smooth.

Habitat.—China-Tibet border.

Holotype, female, near Tang-Gu, altitude 14,000 feet, August 3 to 6, 1930 (*Graham*).

Tipula amytis is distinctly different from the other regional species known to me. The wing pattern suggests certain species of *Acutipula*, but the elongate Rs renders such a subgeneric assignment doubtful.

TIPULA VITIOSA sp. nov. Plate 1, fig. 4.

General coloration gray, the præscutum with four poorly indicated darker gray stripes, the cephalic end of the sclerite with four more brownish areas; nasus unusually broad and weakly notched at apex; antennæ with scape brown, pedicel obscure yellow, flagellum black; wings brown, conspicuously variegated by darker brown and white, the latter including a narrow but complete crossband beyond the cord; vein R_{1+2} persistent, diverging widely from R_3, not much exceeding R_2 alone; abdominal tergites yellow, trivittate with dark brown.

Female.—Length, about 20 millimeters; wing, 17.5.

Frontal prolongation of head light gray above, more infuscated on sides; nasus unusually broad, its apex weakly notched; palpi dark brown. Antennæ with scape brown, pedicel obscure yellow, flagellum black; longest verticils exceeding the segments and unilaterally arranged. Head light gray, the vertex with a capillary brown line.

Mesonotal præscutum light gray, with four poorly indicated, darker gray stripes, the cephalic ends of the intermediate stripes and similar humeral areas before the pseudosutural foveæ light brown, producing a series of four subequal spots on cephalic portion of sclerite; posterior sclerites of mesonotum gray, the centers of the scutal lobes brown, the scutellum and mediotergite more or less suffused with brown. Pleura gray, the dorsopleural membrane buffy. Halteres relatively long, pale yellow, the knobs dark brown. Legs with the coxæ gray; trochanters obscure yellow; femora brownish yellow to obscure yellow, the tips narrowly and weakly darkened; tibiæ light brown, the tips scarcely darkened; tarsi dark brown; tibial spur formula 1–?–2. Wings (Plate 1, fig. 4) with the ground color brown, conspicuously variegated by darker brown and white areas; the

dark markings include the stigma and a confluent area on anterior cord, a spot at origin of Rs, a small post-arcular area, and seams along veins Cu and 2d A; the white areas include a narrow but complete white crossband beyond cord, large jagged areas in cells R and M, the outer one in cell M being V-shaped; origin of Rs entirely surrounded by white areas; cubital and anal cells variegated with white; outer half of cell R_5 with central portion white; cells C and Sc light yellow; veins dark brown. Squama naked; macrotrichia of veins very small and sparse, lacking on R_3. Venation: R_{1+2} entire, without trichia, diverging widely from R_3 and only a little longer than R_2 alone; m and petiole of cell M_1 subequal; m-cu at fork of M_{3+4}.

Abdomen with basal tergite infumed, the succeeding tergites more yellowish to ocherous, with three narrow continuous brown stripes, the median one much narrower than the interspaces; sublateral stripes very broad, margined externally by very narrow pale borders; subterminal segments more uniformly darkened. Ovipositor with the basal shield blackened, polished; cerci horn-colored, long and straight, the margins smooth, the tips obtuse; hypovalvæ relatively short, blackened.

Habitat.—China-Tibet border.

Holotype, female, near Tang-Gu, altitude 14,000 feet, August 3 to 6, 1930 (*Graham*).

Tipula vitiosa is generally similar to *T. leucosema* Edward (Yunnan), especially in the wing pattern, but differs conspicuously in the coloration of the thorax and abdomen. The very broad, weakly notched nasus and the short, suberect R_{1+2} furnish conspicuous characters for the definition of the present fly.

TIPULA VIVAX sp. nov. Plate 1, fig. 5.

General coloration of thorax light gray, the three præscutal stripes concolorous, separated from one another by dark brown areas on the interspaces; scape and pedicel yellow, the flagellum weakly bicolorous; nasus very short and stumpy; halteres yellow, the knobs dark brown; femora yellow, the tips narrowly black; wings pale brown, the prearcular and costal regions abruptly light yellow; a conspicuous white pattern on disk, including a virtually complete crossband beyond cord; R_{1+2} entire; abdomen yellow, the subterminal segments darkened; basal segments narrowly trivittate with brown.

Female.—Length, about 15 millimeters; wing, 14.5.

Frontal prolongation of head brownish yellow; nasus very short and stumpy; palpi dark brown. Antennæ with scape and

pedicel obscure yellow; flagellum very weakly bicolorous, the basal enlargement of each segment dark brown, the remainder paler brown. Head light gray.

Mesonotal præscutum chiefly light gray, this including the broad gray stripes, the interspaces variegated by linear brown dashes, there being two on either side of the median gray stripe; extreme cephalic end of præscutum with a short brown median dash; posterior sclerites of notum gray. Pleura light gray; dorsopleural membrane buffy. Halteres yellow, the knobs abruptly dark brown. Legs with the coxæ light gray; trochanters yellow; femora yellow, the tips narrowly and conspicuously black; tibiæ obscure yellow, the tips narrowly and gradually blackened; tarsi black; tibial spur formula 1–?–2, middle legs broken. Wings (Plate 1, fig. 5) with the ground color pale brown, the prearcular and costal regions light yellow; stigma darker brown than the ground; white areas as follows: A narrow but virtually complete crossband beyond cord, scarcely interrupted by a narrow dark seam along vein M_{1+2}; a broader pale band before cord, extending generally parallel to the first described band, extending across cells R_1, R, and M; large pale areas in bases of cells M and Cu, outer half of Cu, and in bases of anal cells; veins dark brown, flavous in the yellow costal region. Squama naked; numerous macrotrichia on veins beyond cord; distal three-fourths of R_{1+2} naked. Venation: R_{1+2} entire; r-m connecting with Rs at or before fork; cell 1st M_2 relatively small, pentagonal; m-cu connecting with M_4 some distance beyond base.

Abdomen chiefly yellow, the outer segments a little more suffused with darker; very narrow, brown, median and sublateral stripes on tergites, the extreme lateral margins more buffy white; on sternites the three brown stripes are broader, especially the median one. Genital segment and ovipositor yellow; cerci long and slender, nearly straight, with smooth margins.

Habitat.—China-Tibet border.

Holotype, female, Zya-Ha Pass, altitude 14,000 to 17,000 feet, July 25 to 27, 1930 (*Graham*).

The only described regional species that agrees at all closely with the present fly in its small size, persistent R_{1+2}, and in having the wing pattern somewhat similar, is *Tipula pedicellaris* Alexander, which differs in the black scape, distinct præscutal pattern, extensively blackened femora, and incomplete pale crossband beyond cord.

LIMONIINÆ

HEXATOMINI

EPIPHRAGMA OCELLARIS GRACILISTYLUS subsp. nov.

Quite as in typical *ocellaris* (Linnæus), differing in slight characters of the male hypopygium. Outer dististyle slenderer and nearly straight, only the extreme tip decurved. Lobes of tergite obtuse at tips, separated by a U-shaped notch.

Habitat.—Eastern Siberia (Ussuri).

Holotype, male, Tigrowaja, Suchan district, June 16, 1927 (*Stackelberg*).

PSEUDOLIMNOPHILA BRUNNEINOTA sp. nov. Plate 1, fig. 6; Plate 2, fig. 30.

General coloration of mesonotum light reddish brown, without markings; antennæ brownish black throughout, flagellar segments long-cylindrical; halteres dusky; legs chiefly brownish black to black; wings strongly tinged with light brown or yellowish brown, the stigma small, long-oval, darker brown; R_2 about one-half R_{2+3}; m-cu about one-third its length beyond fork of M; abdominal tergites dark brown, the subterminal segments brownish black.

Male.—Length, about 5 to 5.5 millimeters; wing, 5.8 to 6.2.

Rostrum and palpi black. Antennæ brownish black throughout; flagellar segments long-cylindrical, the longest verticils about twice the segments; terminal segment a little longer than the penultimate. Head dark brownish gray.

Pronotum dark brown. Mesonotum light reddish brown, without markings; pleura more yellowish. Halteres dusky. Legs with the coxæ and trochanters testaceous-yellow; remainder of legs brownish black to black, only the femoral bases restrictedly obscure yellow. Wings (Plate 1, fig. 6) with a strong light brown or yellowish brown tinge, the costal region clearer yellow; stigma long-oval, darker brown; veins brown. Costal fringe relatively long; macrotrichia of veins long and abundant, including close series on veins beyond cord. Venation; Sc_1 ending just beyond fork of Rs, Sc_2 near its tip; R_2 about one-half R_{2+3}; R_{2+3+4} only gently arcuated; cell M_1 exceeding its petiole; m-cu about one-third its own length beyond fork of M; anterior arculus preserved.

Abdominal tergites dark brown, the sternite paler; subterminal segments brownish black; hypopygium dark. Male hypopygium (Plate 2, fig. 30).

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, altitude 7,000 feet, July 27, 1931 (*Franck*). Paratopotype, male, July 17, 1931.

The nearest allies of the present fly are *Pseudolimnophila chikurina* Alexander, of Formosa, which differs in the brownish gray coloration of the thoracic notum and pleura, and in the paler legs; and *P. fusca* (Brunetti), of the eastern Himalayas, which differs in the pale legs, brightened first flagellar segment, and presence of a narrow median præscutal stripe.

LIMNOPHILA (IDIOPTERA) USSURIANA sp. nov. Plate 1, fig. 7; Plate 2, fig. 31.

Allied to *trimaculata;* general coloration of thorax gray, the præscutum with indications of four darker brown stripes; antennæ of male of moderate length, the verticils slightly exceeding the segments; femora yellow, the tips narrowly blackened; wings pale yellow, with a heavy brown pattern; abdominal segments bicolorous, the bases pale, the apices brown.

Male.—Length, about 6 millimeters; wing, 7.5; antenna, about 2.4.

Female.—Length, about 7 millimeters; wing, 8; antenna, about 1.7.

Rostrum and palpi black. Antennæ with the scape dark brown, the pedicel and first flagellar segment yellow, remainder of flagellum black; verticils (male) slightly exceeding the segments; terminal segment about two-thirds the penultimate; antennæ (male) much shorter than in *trimaculata,* if bent backward extending to shortly beyond roots of halteres. Head gray.

Mesonotum dark with a heavy gray bloom to virtually obscure the ground; præscutum with vague indications of four darker stripes, these becoming more evident behind; pseudosutural foveæ conspicuous, black; tuberculate pits lacking. Pleura heavily gray pruinose. Halteres pale yellow, relatively long and slender. Legs with the coxæ yellow, the fore coxæ more darkened and pruinose at base; trochanters yellow; femora yellow, the tips narrowly and abruptly black, the amount subequal on all legs, including about the apical eighth or less; tibiæ obscure yellow, the tips narrowly darkened; tarsi chiefly dark brown. Wings (Plate 1, fig. 7) with the ground color pale yellow, the prearcular and costal regions a little brighter yellow; wing tip narrowly and vaguely darker; stigma brown; conspicuous brown clouds and seams, as follows: Origin of Rs, Sc_2, along cord and outer end of cell 1st M_2, fork of M_{1+2}, on supernumerary crossvein in cell M, and as marginal clouds

at ends of veins R_3, M_4, and 2d A; veins brown. Venation: R_{2+3+4} about one-half longer than m-cu.

Abdominal tergites dark brown caudally and laterally, the remainder of disk obscure yellow; sternites pale yellow, the caudal margins of segments weakly darkened; segments eight and nine more uniformly dark brown, the basistyles of male hypopygium yellowish. In the female, the abdominal tergites are more uniformly darkened; valves of ovipositor long and slender. Male hypopygium (Plate 2, fig. 31) with the outer dististyle, *od*, relatively slender, the apex suddenly narrowed, the outer margin of distal half with abundant microscopic appressed spinulæ.

Habitat:—Eastern Siberia (Ussuri).

Holotype, male, Tigrowaja, Suchan district, June 9, 1927 (*Stackelberg*). Allotopotype, female.

The only close ally of the present fly is *Limnophila* (*Idioptera*) *trimaculata* (Zetterstedt), a somewhat uncommon species of northern Europe, which differs in the more-elongate antennæ of the male, the more extensively blackened legs, and the less heavily patterned wings. The male hypopygium is very similar in the two species. The other European members of *Idioptera*, together with the three Nearctic species, all have the male hypopygia of entirely different structure. The relatively short antennæ of the male of the present fly approach the condition found in some species of the subgenus *Elæophila* Rondani (as the Nearctic *sabrina* Alexander), supporting Edwards's contention that the two groups are not sufficiently distinct for subgeneric separation.

LIMNOPHILA (DICRANOPHRAGMA) MELALEUCA sp. nov. Plate 1, fig. 8.

Size very small (wing, male, 4.5 millimeters); general coloration of mesonotum brownish gray, the præscutum with dark lines on interspaces; knobs of halteres conspicuously dark brown; femora brownish testaceous, with a pale brown subterminal ring, the tips narrowly but conspicuously white; wings (male) broadest opposite level of termination of vein 2d A; dark pattern confined to vicinity of veins; cells M to 2d A, inclusive, extensively washed with dusky.

Male.—Length, about 4 millimeters; wing, 4.5.

Rostrum and palpi black. Antennæ with the scape and pedicel black; flagellum obscure yellow, the outer segments darker. Head dark.

Mesonotal præscutum brownish gray, with a submedian, brown, longitudinal stripe, occupying the usual interspaces, with a spotlike area of the same color lying on outer margin of the usual lateral stripe, behind the pseudosutural foveæ; posterior sclerites of mesonotum darkened, sparsely pruinose. Pleura chiefly dark brown, sparsely pruinose. Halteres pale yellow, the knobs dark brown. Legs with the coxæ and trochanters brownish black; femora pale brownish testaceous, deepening to a pale brown subterminal ring, the subequal tips abruptly white; tibiæ and tarsi yellow. Wings (Plate 1, fig. 8) broadest at level of termination of vein 2d A; disk chiefly white, cells M, Cu, 1st A, and 2d A extensively washed with dusky, except at outer ends; a series of darker brown marginal spots, including six major areas along costa, the fourth and fifth confluent, lying above the fork of R_{2+3+4} and on R_2; cord, outer end of cell 1st M_2 and fork of M_{1+2} narrowly seamed with brown; veins dark in the clouded areas, pale yellow in the interspaces.

Abdomen, including hypopygium, dark brown.

Habitat.—Japan (Kyushu).

Holotype, male, Wakasugiyama, Chikuzen, August 7 to 9, 1931 (*Esaki et al.*).

Limnophila (*Dicranophragma*) *melaleuca* is readily told by the diagnostic features listed above, notably the small size, darkened knobs of halteres, white femoral tips, and expanded wings of male.

LIMNOPHILA (DICRANOPHRAGMA) MELALEUCA IGNAVA subsp. nov.

Male.—Length, about 4 to 5 millimeters; wing, 5.

Female.—Length, about 5.5 millimeters; wing, 6.2.

Characters as in the typical form, differing especially in the slightly larger size and slight details of coloration.

Wings with the darkening in cells Cu to 2d A less developed to nearly obsolete; dark marginal areas at ends of longitudinal veins larger, tending to become confluent with one another and with the submarginal darkenings at the supernumerary crossvein in cell R_2 and the area at fork of M_{1+2}.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, altitude 7,000 feet, July 29, 1931 (*Franck*). Allotopotype, female, altitude 4,500 feet, August 12, 1931.

LIMNOPHILA (DICRANOPHRAGMA) LÆTITHORAX sp. nov. Plate 1, fig. 9; Plate 2, fig. 32.

General coloration dark brown or brownish black, the mesonotal præscutum and scutum more reddish brown, without

markings; wings broad in male, narrower in female, the costal fringe relatively short in both sexes; wings with numerous dots in the cells, additional to the five major brown costal spots.

Male.—Length, 5.5 to 6 millimeters; wing, 6.5 to 8.

Female.—Length, 6.5 to 7 millimeters; wing, 6.5 to 7.

Rostrum and palpi black. Antennæ black, the first flagellar segment light yellow, the remainder of flagellum brownish black. Head brownish gray.

Mesonotal præscutum and scutum reddish brown pollinose, much brighter in color than the blackened, sparsely pruinose mediotergite and pleura; præscutum without darker markings with the exception of the black pseudosutural foveæ, and, in cases, a narrow outer margin to the outer lateral stripe. Halteres pale yellow. Legs with the coxæ blackened, sparsely pruinose; trochanters obscure yellow, blackened apically beneath; remainder of legs light yellow, the last tarsal segment darkened. Wings (Plate 1, fig. 9) broad in male, narrower in female; ground color pale cream-yellow, with a spotted and dotted brown pattern, the major areas including a series of five costal darkenings, one being postarcular, the second at origin of Rs, the third and fourth more or less confluent at the fork of Rs, leaving a pale spot between them in costal field; last major area at supernumerary crossvein; cord and outer end of cell 1st M_2 more narrowly seamed with brown; small circular brown dots in all cells, together with a series of slightly larger similar marginal spots at ends of all longitudinal veins; veins light yellow, darker in the infuscated areas. Costal fringe relatively short in both sexes, dark brown; in female, the setæ are somewhat shorter than the width of the costal cell. Venation: m-cu at near midlength of cell 1st M_2; cell M_1 shorter than its petiole.

Abdomen dark brown, the hypopygium more brownish yellow to yellow. Male hypopygium (Plate 2, fig. 32) with the outer dististyle, *od*, strongly bidentate at apex; inner dististyle, *id*, broad basally, narrowed outwardly, the apex with a series of four strong setæ in a single row.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, altitude 7,000 feet, July 27, 1931 (*Franck*). Allotopotype, female, pinned with type. Paratopotypes, 4 males and females, July 17 to 27, 1931 (*Franck*).

Limnophila (*Dicranophragma*) *lætithorax* is most nearly allied to the Formosan *L.* (*D.*) *taiwanensis* Alexander, which differs in the less-brightened mesonotal præscutum that is nar-

rowly lined with brown on the interspaces, the more abundant dotted areas on wings, and the long, light yellow, costal fringe in the female, the trichia being approximately as long as the width of the costal cell.

LIMNOPHILA MARTYNOVI sp. nov. Plate 1, fig. 10.

General coloration light gray, the præscutum with two darker gray intermediate stripes; pseudosutural foveæ and tuberculate pits black, very conspicuous; femora yellow basally, the apices blackened, broadly so on forelegs; wings with the ground color yellow, with a heavy brown-spotted pattern; m and m-cu lacking; veins beyond cord almost without macrotrichia.

Female.—Length, about 10.5 millimeters; wing, 8.5.

Rostrum gray; palpi black. Antennæ 16-segmented, black, the scape heavily light gray pruinose; flagellar segments gradually decreasing in size outwardly, the terminal segment longer than the penultimate; verticils longer than the segments. Head light gray; eyes small, with fine ommatidia; anterior vertex wide; head prolonged behind eyes.

Pronotum large and conspicuous, gray. Mesonotal præscutum light gray, with two darker gray intermediate stripes; pseudosutural foveæ and tuberculate pits black, very conspicuous, the latter lying at cephalic portion of sclerite, diverging anteriorly; posterior sclerites of notum clear light gray, the scutal lobes vaguely marked with darker. Pleura, including the dorsal membrane, gray. Halteres pale, the knobs very weakly darkened. Legs with the coxæ light gray; trochanters brownish yellow; femora broadly blackened apically, the bases yellow, the black most extensive on forelegs where about the distal three-fourths is included, narrowest on the posterior legs where about the outer third or fourth is darkened; tibiæ yellowish brown, the tips narrowly darkened; tarsi black; legs with conspicuous setæ. Wings (Plate 1, fig. 10) with the ground pale yellow, with a heavy brown spotted and dotted pattern; costal cell chiefly dark brown by a series of extensive areas that are confluent on basal half of cell, cell Sc more extensively clear; large, paler brown areas at origin of Rs, along cord, and as postarcular darkenings in bases of cells R and M; marginal clouds at ends of all longitudinal veins; small brown dots in outer radial field and in cells M to 2d A, chiefly grouped along the veins; cells R_1, R, and M are chiefly clear of markings; veins brown. Macrotrichia of veins beyond cord very sparse, restricted to veins R_1 and R_{1+2}, and as a scattered series the entire length of R_5, more numerous and crowded on distal fifth; no trichia on anal

veins and only one or two at outer end of Cu. Venation: R_{2+3+4} shorter than basal section of R_5; cell M_1 present; cell 1st M_2 open by atrophy of m; m-cu entirely lacking; anterior arculus preserved.

Abdomen dark gray, the tergites more suffused medially with brownish. Ovipositor with the cerci powerful, blackened on basal third, the horn yellow tips strongly upcurved.

Habitat.—Eastern Siberia (Ussuri).

Holotype, female, Maiche region, near Shkotowo, 132° 20′ east longitude, 43° 20′ north latitude, June 5, 1927 (*Martynov*); No. 205.

Limnophila martynovi is named in honor of the collector, Dr. A. Martynov, who has collected many interesting Tipulidæ in Ussuri. The single specimen available indicates a fly of unusual interest. The remarkable venation, wtih both m and m-cu lost by atrophy, is different from that in all related forms and certainly appears to represent a normal condition, since the two wings are quite alike. The exact systematic position of the fly is rendered in question because of the loss of m-cu and the sex of the specimen. The general features of venation are not unlike those found in *Dactylolabis* or *Limnophila*, sensu strictu, and if we disregard the two venational features above mentioned, the general appearance of the insect would be much as in either of these groups. All species of the two groups known to me, including virtually all of the described species, have numerous macrotrichia on the veins beyond the cord. I am inclined to believe that the present fly will be found to fall in or close to the typical subgenus *Limnophila*.

Genus HEXATOMA Latreille

Hexatoma LATREILLE, Gen. Crust. et Ins. 4 (1809) 210.

Subgenus ERIOCERA Macquart

Eriocera MACQUART, Dipt. exot. 1 1 (1838) 74.

Edwards[2] has reviewed critically the numerous names that have been proposed in the subgenus *Eriocera*, indicating those that deserve consideration as being valid. I certainly agree that *Penthoptera* should be placed in the strict synonymy of *Eriocera*. There remain three names that are here considered as representing valid subgenera under the oldest name, *Hexatoma*.

[2] Ann. & Mag. Nat. Hist. IX 8 (1921) 67–99.

1. *Hexatoma* Latreille. Wings with cell R_3 present and with only two branches of M attaining the wing margin (M_{1+2} and M_4). Valves of ovipositor short and fleshy. As so restricted, the subgenus includes about eight valid species in Europe, one in Japan, and two in boreal America.

2. *Cladolipes* Loew. Characters as in *Hexatoma* but with cell R_3 of wings lost by fusion of veins R_3 and R_4 to margin. The group includes a single species, *simplex* Loew, of Greece.

3. *Eriocera* Macquart. All species have cell R_3 present. The number of free branches of media ranges from two to four, the low figure being found in a single species from the Seychelles Islands, which otherwise differs from *Hexatoma,* s. s., in the elongate valves of the ovipositor. The venation of the outer medial field is wonderfully plastic, and in many species these veins tend to become weak or even semiatrophied. An entirely comparable case is found in the eriopterine genus *Trentepohlia* Bigot. Ovipositor with elongate sclerotized valves, more rarely (*longicornis* group) with these short and fleshy. As so interpreted, *Eriocera* includes the vast bulk of the genus, with approximately two hundred species distributed in all temperate and tropical regions and subregions, with the exceptions of the Chilian and Maorian.

There seems to be no question but that the three groups here recognized are very closely allied and are maintained for convenience in handling the vast complex of species. The three subgenera may be separated as follows:

1. Wings with three or four branches of media attaining the margin; when only two such branches are found (*ferruginea* Edwards, Seychelles Islands); the ovipositor with sclerotized cerci..... *Eriocera* Macquart.
   Wings with but two branches of media attaining the margin; ovipositor with fleshy valves ..... 2.
2. Wings with cell R_5 lacking..... *Cladolipes* Loew.
   Wings with cell R_5 present..... *Hexatoma* Latreille.

As a result of placing these groups in a single genus, a few names have become preoccupied and the species are renamed as follows:

HEXATOMA (ERIOCERA) BENGALENSIS nom. nov.

Hexatoma (*Eriocera*) *bicolor* MACQUART, Dipt. exot. 1 1 (1838) 66, non *Hexatoma* (*Hexatoma*) *bicolor* MEIGEN, Syst. Beschreib. 1 (1818) 209.

HEXATOMA (ERIOCERA) MADAGASCARIENSIS nom. nov.

Hexatoma (*Eriocera*) *obscura* BIGOT, Ann. Soc. Ent. France III 7 (1859) 123, non *Hexatoma* (*Hexatoma*) *obscura* MEIGEN, Syst. Beschreib. 1 (1818) 210.

HEXATOMA (ERIOCERA) WIEDEMANNI nom. nov.

Hexatoma (Eriocera) nigra WIEDEMANN, Aussereur. zweifl. Ins. 1 (1828) 27, non *Hexatoma (Hexatoma) nigra* LATREILLE, Gen. Crust. et Ins. 4 (1809) 260.

The species later described as *nigra* by Macquart (1838), and which is of unusual importance in the discussion in that it is the type of the subgenus, is herewith considered as being distinct from *nigra* Wiedemann. Enderlein (1912) described a species from Colombia as *Eriocera macquarti*, under the belief that the fly was conspecific with Macquart's *nigra*. This Colombian insect differs in certain important regards from Macquart's description and I am very doubtful that it will be found to be the same as Macquart's species. The presence of a red vertical tubercle in *macquarti* Enderlein but not in *nigra* Macquart renders the synonymy very doubtful.

HEXATOMA (ERIOCERA) LANIGERA sp. nov. Plate 1, fig. 11.

Belongs to the *spinosa* group; general coloration brownish gray, in male the præscutum with a conspicuous, dark brown, median stripe; antennæ (male) elongate, approximately three times the length of body; body (male) conspicuously hairy; legs black, the femoral bases narrowly but conspicuously bright yellow; wings brown, the prearcular region more yellowish.

Male.—Length, about 17 to 18 millimeters; wing, 20 by 4.8; antenna, about 50 to 55.

Female.—Length, about 25 millimeters; wing, 19; antenna, about 5.

Male.—Rostrum and palpi black. Antennæ black throughout, approximately three times the length of the body; flagellar segments with coglike spines, as in group. Head grayish brown, with a dense pale pubescence; vertical tubercle conspicuous.

Mesonotal præscutum brownish gray, clearer gray on humeral and lateral portions, with a conspicuous dark brown median line; posterior sclerites of notum more grayish; notum with conspicuous erect setæ. Pleura blackish, heavily pruinose with light gray, especially on the ventral portions. Halteres brown, the knobs brownish black. Legs with the coxæ gray pruinose; trochanters brownish black, sparsely pruinose; femora black, the bases broadly bright yellow, including about the basal third or fourth on the fore and middle legs, about the basal fifth on the posterior femora; remainder of legs black. Wings (Plate 1, fig. 11) relatively narrow, with a strong brown tinge, the costal region somewhat darker; prearcular region more yellowish; stigma barely indicated; a dark seam along vein Cu;

centers of basal cells from R to 2d A paler than the borders; veins brown. Macrotrichia of veins very sparse; costal fringe short and appressed; veins beyond cord without trichia, excepting a few scattered ones on distal section of vein R_5. Venation: R_{2+3} longer than R_{1+2}, the latter about three times R_2 alone; cell M_1 present but variable in size; m-cu at or close to midlength of cell 1st M_2.

Abdomen chiefly dark brown, the sternites pruinose; hypopygium light brown to yellowish brown; abdomen conspicuously hairy.

Female.—Generally similar to male except in the sexual features of short antennæ and short, inconspicuous pubescence of the body. Median dark stripe on præscutum lacking.

Habitat.—China-Tibet border.

Holotype, male, Yin-Kuan-Tsai, altitude 13,000 to 15,000 feet, July 25, 1930 (*Graham*). Allotopotype, female. Paratopotype, male.

Hexatoma (*Eriocera*) *lanigera* is closest to *H.* (*E.*) *stricklandi* (Edwards), of Japan, differing most evidently in the dark coloration of the wings and the distinct pattern of the legs, which in the present fly are black with only the femoral bases narrowly yellow.

HEXATOMA (ERIOCERA) TIBETANA sp. nov. Plate 1, fig. 12.

Belongs to the *spinosa* group; general coloration gray; vestiture of body short in both sexes; antennæ (male) of moderate length, subequal to the body; femora broadly yellow basally, the tips blackened, narrowly so on fore and middle legs, broadly on posterior femora; wings fulvous, stigma small, brown; cell M_1 present; abdominal tergites brownish black, the sternites and genital region of both sexes yellowish.

Male.—Length, 15 to 16 millimeters; wing, 18 by 4.8 to 20 by 5.1; antenna, 15 to 16.

Female.—Length, about 25 millimeters; wing, 21 by 6.

Male.—Rostrum dark brown; palpi black. Antennæ of moderate length, approximately as long as body, black throughout; flagellar segments with the usual armature of spines. Head brownish gray; vertical tubercle very large and protuberant.

Mesonotal præscutum yellowish gray, with three darker, more brownish stripes, in addition to a narrow, more blackish, median vitta; lateral stripes small and relatively indistinct; lateral border of sclerite narrowly blackish; posterior sclerites of mesonotum chiefly brownish gray; vestiture of notum reduced to small, dark-colored setæ. Pleura heavily light gray pruinose,

with scattered elongate whitish setæ. Halteres dark brown. Legs with the coxæ light gray, with long pale setæ; trochanters yellow; femora chiefly bright yellow, the tips blackened, on fore and middle legs narrowly so, involving about the basal third or fourth, on posterior legs more extensively, including about the outer two-thirds; tibiæ brown; tarsi darker brown. Wings (Plate 1, fig. 12) with a strong fulvous tinge, the prearcular region and cell Sc brighter yellow; stigma small, brown; centers of most of cells with paler, more grayish centers; veins yellowish brown. Macrotrichia of veins very scanty, as is the case in almost all members of the group. Venation: Cell M_1 present.

Abdominal tergites brownish black, the extreme lateral margins pale; sternites yellow; hypopygium brownish yellow; abdomen with inconspicuous short white setæ.

Female.—Characters as in male, except in the sexual differences. Halteres with stem light brown, the knobs dark brown. Ovipositor with the elongate tergal shield fulvous; valves elongate, nearly straight.

Habitat.—China-Tibet border.

Holotype, male, near Tang-Gu, altitude 14,000 feet, August 3 to 6, 1930 (*Graham*). Allotopotype, female. Paratype, 1 male, Tatsienlu, altitude 8,000 to 9,000 feet, August 16, 1930.

Hexatoma (*Eriocera*) *tibetana* is readily told from the allied *H.* (*E.*) *lanigera* sp. nov. by the much shorter antennæ of the male and the short vestiture of the thoracic notum in the male.

HEXATOMA (ERIOCERA) MEDIOFILA sp. nov. Plate 1, fig. 13.

Belongs to the *spinosa* group; mesonotum yellowish gray, the præscutum with a median blackish vitta and blackened lateral margins; antennæ relatively short, subequal in length to the body; legs black, the femoral bases rather narrowly yellow; wings with a strong fulvous-brown tinge; stigma small, brown; cell M_1 lacking; abdominal tergites black, sternites obscure yellow.

Male.—Length, about 13.5 millimeters; wing, 16 by 4.1; antenna, 13.

Rostrum yellow, grayish pruinose; palpi elongate, black. Antennæ black throughout, subequal in length to body; flagellar segments with the usual spines and spinous setæ found in males of this group. Head brown; vertical tubercle large; setæ of head long, dark-colored.

Mesonotal præscutum yellowish gray, with a broad, median, pale brown stripe that is further split by a narrow blackish vitta; lateral stripes ill-defined, grayish; posterior interspaces

more yellowish; lateral margins of sclerite narrowly blackish; posterior sclerites of mesonotum blackish, very sparsely pruinose, the scutellum more heavily so; vestiture of notum short, chiefly pale. Pleura blackish, light gray pruinose, with sparse pale elongate setæ. Halteres pale brown, the knobs dark brown. Legs with the coxæ pruinose, with sparse pale setæ; trochanters yellowish; femora yellow basally, the tips very broadly blackened, on forelegs including about the outer two-thirds, on middle legs one-third, on posterior legs slightly more than four-fifths; tibiæ and tarsi black. Wings (Plate 1, fig. 13) relatively narrow, with a strong fulvous-brown tinge; prearcular region and cell Sc clear light yellow; stigma small, brown; veins pale brown. Venation: Cell M_1 lacking.

Abdominal tergites black; sternites obscure yellow, variegated sublaterally by pale brown; hypopygium dark; vestiture of abdomen relatively long and pale.

Habitat.—China-Tibet border.

Holotype, male, Yu-Long-Si, altitude 15,600 feet, July 28, 1930 (*Graham*).

Despite the lack of cell M_1 of the wings, I am referring this insect without question to the *spinosa* group, where it is unique in this venational feature. It is most similar to *Hexatoma* (*Eriocera*) *tibetana* in the general appearance and relative length of the antennæ of the male and differs in the notable increase in the amount of black on femora.

HEXATOMA (ERIOCERA) STACKELBERGI sp. nov. Plate 1, fig. 14.

Belongs to the *verticalis* group; general coloration gray pruinose; antennæ (male) short; mesonotal præscutum with three brownish black stripes; knobs of halteres pale yellow; legs black, with about the basal half of femora yellow; wings whitish subhyaline, all veins bordered by brown; R_{1+2}, R_2, and R_{2+3} subequal; cell 1st M_2 elongate; abdomen stout, black, conspicuously clothed with black setæ; hypopygium large, black.

Male.—Length, about 8 to 9 millimeters; wing, 7.5 to 9.

Rostrum and palpi black. Antennæ (male) short, if bent backward not attaining the wing root, 7-segmented; black, the basal segment pruinose; flagellar segments gradually decreasing in length, the terminal segment about one-half the penultimate. Head gray pruinose, the broad vertical tubercle more whitish gray.

Mesonotal præscutum gray with three brownish black stripes; scutum gray, each lobe with two brownish black areas; posterior sclerites of notum light gray; setæ of notum short and incon-

spicuous. Pleura gray, the dorsopleural membrane dark. Halteres dusky at bases, the knobs and outer half of stem light yellow. Legs with the coxæ and trochanters black, the former pruinose; femora with slightly more than the basal half light yellow, the outer portion black; remainder of legs black. Wings (Plate 1, fig. 14) whitish subhyaline, all veins bordered by brown to give a streaked appearance. Macrotrichia of veins very sparse or lacking; costal fringe short but dense; veins beyond cord without trichia excepting a scattered series of relatively long ones the entire length of outer section of vein R_5, more crowded on distal third. Venation: R_{1+2}, R_2, and R_{2+3} all subequal; R_{2+3+4} about two-thirds R_3; cell 1st M_2 long, about equal to the longest vein beyond it, the latter elements not showing signs of atrophy; m-cu just beyond fork of M.

Abdomen stout, black, with abundant coarse erect setæ; hypopygium large, black, the narrow tergal plate polished black.

Habitat.—Eastern Siberia (Ussuri).

Holotype, male, Tigrowaja, Suchan district, June 8, 1927 (*Stackelberg*). Paratopotypes, 2 males, June 9 to 11, 1927.

Hexatoma (*Eriocera*) *stackelbergi* is named in honor of the collector, Dr. A. von Stackelberg, whose extensive collections in Ussuri have vastly enriched our knowledge of this region. The species is quite different from all other regional members of the subgenus, being most nearly related to *H.* (*E.*) *nipponensis* (Alexander) and allies, differing in the brown borders to the veins, the nearly glabrous outer veins of wing, the stout abdomen with unusually large hypopygium, and other characters. The fly is likewise generally similar and not distantly allied to *H.* (*E.*) *austera* (Doane), of western North America.

HEXATOMA (ERIOCERA) GIFUENSIS sp. nov. Plate 1, figs. 15, 16; Plate 2, fig. 33.

Belongs to the *verticalis* group; general coloration black, probably pruinose in fresh specimens; antennæ (male) elongate, being approximately three times the body, the flagellar segments with numerous slender spines; tips of femora blackened; wings with a faint yellow tinge, the stigma dark brown; R_{2+3+4} about two-thirds to three-fourths the length of R_3 alone; m-cu a short distance beyond fork of M.

Male.—Length, about 12 millimeters; wing, 12; antenna, about 30.

Female.—Length, 13 to 14 millimeters; wing, 10.5 to 11.5; antenna, about 2.2.

Described from alcoholic specimens.

Rostrum brown; palpi black. Antennæ of male elongate, nearly three times the body; basal segment brownish yellow, flagellum black; flagellar segments with conspicuous erect spines; antennæ of female 10-segmented. Head dark brown, the genæ brighter; vertical tubercle of male unusually large and high, of female smaller but still conspicuous.

Mesonotum and pleura black, probably pruinose in fresh specimens, any bloom or stripes that may be present destroyed by immersion; interspaces (male) with a dense erect pale pubescence. Halteres pale, the knobs dark brown. Legs with the coxæ darkened basally, the tips brighter; trochanters of male brownish black, of female more yellowish; femora yellow, the tips narrowly blackened; tibiæ and basitarsi brownish yellow, the tips narrowly blackened; outer tarsal segments black; segments of legs with conspicuous setæ. Wings (Plate 1, fig. 15) with a faint yellow tinge, the costal region clearer yellow; stigma dark brown; cord and vein Cu narrowly seamed with brownish; veins brown, Sc more yellowish. Macrotrichia of veins beyond cord very scanty, occurring on distal section of R_5. Venation: R_{2+3+4} about two-thirds to three-fourths R_3 alone; R_{2+3} subequal to R_2; m-cu a short distance beyond fork of M, the distance not exceeding one-third the length of m-cu itself.

Abdomen black. Male hypopygium (Plate 2, fig. 33) with the apical spine of the outer dististyle, *od*, long and nearly straight; only a few, very weak denticles on ventral side at base of spine.

Habitat.—Japan (Honshiu).

Holotype, alcoholic male, Gifu, Mino, June 6, 1931 (*Kariya*).

Allotopotype, alcoholic female. Paratopotypes, 2 broken alcoholic females.

Hexatoma (*Eriocera*) *gifuensis* differs from *H.* (*E.*) *moriokana* (Matsumura) in the dark coloration of the body, the brown wing veins, and the details of venation, notably the position of m-cu at or just beyond the fork of M. Edwards has contended that *moriokana* is a synonym of *verticalis* (Wiedemann), but if Matsumura's description and figure of *moriokana*[3] are approximately correct, this can hardly be the case. The present fly is certainly distinct from *verticalis*, the wing of which is shown for comparison (Plate 1, fig. 16), the obliquity of the cord being a conspicuous character. There are certain discordant features in Matsumura's account of his species. His figure shows the

[3] Thousand Insects Japan, Additamenta 2 (1916) 470–471, pl. 25, fig. 11.

elongate antennæ of a male attached to the body of a female. The length of the antennæ of *moriokana* as given by Matsumura (78 millimeters) is obviously too great. The description calls for a length about four times that of the body and might be assumed to total approximately 38 to 40 millimeters.

HEXATOMA (ERIOCERA) OMEIANA sp. nov. Plate 1, fig. 17.

Belongs to the *verticalis* group; general coloration gray, the præscutum with four shiny black stripes; antennæ (female) 11-segmented; knobs of halteres dark brown; femora yellow, the tips blackened, broadly so on the forelegs, more narrowly on posterior femora; wings with a faint brown tinge; stigma oval, darker brown; veins very insensibly seamed with darker; R_{2+3} very short to lacking; R_{2+3+4} subequal to distal section of R_3.

Female.—Length, about 11 to 12 millimeters; wing, 9 to 11.5; antenna, about 2.3 to 2.5.

Rostrum reddish brown; palpi black. Antennæ (female) 11-segmented, if bent backward ending before the wing root; flagellar segments gradually decreasing in length outwardly, the first segment subequal to the succeeding three segments combined; scape, pedicel, and extreme base of first flagellar segment yellowish on lower surface, the remainder of organ black. Head black, with a sparse gray bloom; vertical tubercle of moderate size, subnitidous.

Mesonotal præscutum gray, with four shiny black stripes, the intermediate pair ending before suture, more or less confluent at their cephalic ends; posterior sclerites of notum light gray pruinose, the scutellum more heavily so. Pleura, including the dorsopleural region, dark gray. Halteres pale, the knobs dark brown. Legs with the coxæ gray pruinose; trochanters with outer faces infuscated, the inner aspect yellow; femora yellow basally, the tips blackened, somewhat more broadly so on forelegs where approximately the basal half or more is darkened, narrowly on the posterior femora where the outer fifth or sixth is blackened; one paratype shows all femora with the tips only narrowly blackened; tibiæ light brown, the tips narrowly black; tarsi black. Wings (Plate 1, fig. 17) with a faint brown tinge; stigma oval, slightly darker brown; veins brown, very insensibly margined with dusky. Macrotrichia of veins relatively sparse, beyond cord with a dense series on distal section of vein R_5, and, in cases, with one or two trichia on either or both outer sections of M_{1+2}; costal fringe dense. Venation: R_{2+3} very short to lacking; R_{1+2} a little exceeding R_2; R_{2+3+4} elongate, subequal

to or a trifle shorter than R_3; m-cu variable in position, from being placed at fork of M to a distance beyond this fork about equal to one-half the length of m.

Abdomen black, subnitidous. Ovipositor with the unusually long and slender cerci horn-colored, the basal shield blackened at base.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, altitude 4,000 feet, August 10, 1931 (*Franck*). Paratopotypes, 8 females, August 9 to 10, 1931.

By Edwards's key to the Old World species of *Eriocera*, the present fly runs out at couplet 22, agreeing most nearly with *Hexatoma* (*Eriocera*) *nigrina* (Riedel), of Formosa, which differs in the uniformly darkened wings and shorter vein R_{2+3+4}.

HEXATOMA (ERIOCERA) LUTEICOSTALIS sp. nov. Plate 1, fig. 18.

Belongs to the *longicornis* group; general coloration gray, the præscutum with three brown stripes, the median one divided by a capillary dark brown vitta; antennæ (male) a little more than three times the length of body; spines of flagellar segments unusually scanty; wings with a faint brownish yellow tinge, the prearcular and costal regions light yellow; R_{2+3} long, from one-third to more than one-half R_{2+3+4}; m-cu close to fork of M (male) or slightly beyond (female).

Male.—Length, about 10 millimeters; wing, 12.2; antenna, about 33.

Female.—Length, about 9 millimeters; wing, 11; antenna, about 2.

Rostrum and palpi brownish black, the latter small and slender. Antennæ (male) elongate, slightly exceeding three times the body; scape enlarged, dark brown; pedicel very small, yellowish brown; flagellum black, the base of first segment obscure yellow; spines of the flagellum very scanty, on the basal segment there are about five, restricted to the distal half of segment; segment two with about eighteen spines, of which only six or seven are large, the alternate ones being microscopic; third flagellar segment with about seven large spines from tuberculate bases, with two or three smaller spines and delicate setæ arranged between the members of each pair of tubercles; terminal segment with only small scattered spinulæ. In female, antennæ 9-segmented, gradually decreasing in length to near end, the terminal three segments small and nearly equal in size. Head

brownish gray; vertical tubercle (male) very large, of female smaller but still conspicuous.

Mesonotal præscutum gray, with three slightly darker brown stripes, the median one divided by a capillary dark brown vitta; posterior sclerites of notum yellowish gray, the scutal lobes variegated by ill-delimited brown areas; notum of male with dense erect pale setæ, that of female with setæ somewhat shorter but still long and conspicuous. Pleura gray pruinose. Halteres pale, the knobs very weakly darkened. Legs with the coxæ dark-colored, pruinose; trochanters obscure yellow; femora brownish yellow, the tips rather narrowly blackened; tibiæ and tarsi brown, of forelegs considerably darker than the hind legs. Wings (Plate 1, fig. 18) with a faint brownish yellow tinge, the prearcular and costal regions clear light yellow; stigma relatively small, pale brown, distinct; scarcely indicated darker seams along cord and veins Cu and R_5; veins dark brown, pale yellow in the flavous areas. Veins with very sparse macrotrichia; costal fringe abundant but the trichia very tiny and appressed; no trichia on veins beyond cord excepting very sparse microscopic ones on R_5 and in stigmal region of vein $R_1 + Sc_2$. Venation: R_{2+3} unusually long for a member of this group, somewhat variable, ranging from one-third to more than one-half R_{2+3+4}; R_{1+2} and R_2 subequal; m-cu close to fork of M (male) or slightly beyond this fork (female).

Abdomen brownish gray, including hypopygium. Ovipositor with small fleshy valves, as in the group.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, altitude 3,500 feet, August 17, 1931 (*Franck*). Allotopotype, female, pinned with type. Paratopotype, female, August 16, 1931 (*Franck*).

The closest ally of the present fly is the Nearctic *Hexatoma* (*Eriocera*) *longicornis* (Walker), which has the antennæ of the female 11-segmented, the flagellum of the male antenna with abundant conspicuous spines, the costal border of the wings strongly darkened, and numerous other characters. The species differs from the two other Asiatic members of the *longicornis* group, *nudivena* sp. nov. and *subpusilla* sp. nov., in the distinct stigmal area and the venation, especially the long R_{2+3}, which is always much longer than R_2 alone. The clear yellow costal border of the wings and the presence of nine antennal segments in the female provide other characters for the ready separation of the species.

HEXATOMA (ERIOCERA) NUDIVENA sp. nov. Plate 1, fig. 19.

Belongs to the *longicornis* group; general coloration of body brown, the præscutum with three slightly darker brown stripes; pleura and coxæ pruinose; wings with a strong dusky tinge; stigma lacking; macrotrichia of veins very sparse or lacking; outer medial veins subobsolete.

Female.—Length, about 9 millimeters; wing, 11.2.

Rostrum and palpi black. Antennæ broken beyond the third segment, black. Head brownish black; vertical tubercle long and conspicuous.

Mesonotum uniform medium brown, the præscutum with three somewhat darker, ill-defined stripes; scutellum gray pruinose. Thorax with only very short blackened setæ. Pleura black, heavily gray pruinose. Halteres short, brownish black throughout. Legs with the coxæ gray pruinose; trochanters black; femora obscure brownish yellow, the tips blackened; remainder of legs black. Wings (Plate 1, fig. 19) with a strong dusky tinge; stigma lacking; veins brown. Macrotrichia of veins very sparse; costal fringe short but abundant; no trichia on veins beyond cord excepting a scanty series on distal section of R_5. Venation: Crossvein h arcuate; R_{2+3+4} and R_3 subequal; R_{1+2} a little longer than R_2; R_{2+3} very short to subobsolete; outer medial veins tending to become obsolete, the distal two-thirds of M_3 and M_4 scarcely evident; m-cu subequal to distal section of Cu_1, placed just beyond fork of M.

Abdomen dark brown, more or less pruinose. Ovipositor with fleshy valves, the hypovalvæ longer than the cerci, moderately sheathing.

Habitat.—China-Tibet border.

Holotype, female, Zya-Ha Pass, altitude 14,000 to 17,000 feet, July 25 to 27, 1930 (*Graham*).

By Edwards's key to the Old World species of *Eriocera*[4] the present fly runs to the second half of couplet 11, where it disagrees with all further species in the fleshy valves of the ovipositor. This fly, with *luteicostalis* sp. nov., and *subpusilla* sp. nov., are unquestionably members of the *longicornis* group which Edwards was inclined to place in the typical subgenus *Hexatoma* rather than in *Eriocera*, despite the retention of three outer medial veins in all members of the group.

[4] Ann. & Mag. Nat. Hist. IX 8 (1921) 70–78.

HEXATOMA (ERIOCERA) SUBPUSILLA sp. nov. Plate 1, fig. 20.

Belongs to the *longicornis* group; general coloration gray; antennæ (female) 6-segmented; mesonotal præscutum with three darker gray stripes; legs pale brown, the femoral tips narrowly brownish black; wings pale grayish, entirely immaculate; R_{2+3+4} longer than R_3; R_2 just beyond fork of R_{2+3+4}.

Female.—Length, about 8 millimeters, wing, 8.

Mouth parts and palpi much reduced. Antennæ only 6-segmented, brown, the basal three segments somewhat paler brown; flagellar segments decreasing in length outwardly, the terminal segment only about one-third to one-half the length of the fifth. Head gray, the vertical tubercle very poorly developed.

Mesonotum light gray, the præscutum with three darker gray stripes that are very poorly delimited against the ground. Pleura gray, the dorsopleural membrane dusky. Halteres pale. Legs with the coxæ gray; remainder of legs pale brown, the tips of femora narrowly brownish black. Wings (Plate 1, fig. 20) uniformly pale grayish, with no costal brightening, entirely immaculate; veins brown. Costal fringe reduced to abundant small setæ; trichiation of veins beyond cord reduced to a scattered series on distal two-thirds of R_5 and a few on vein $R_1 + Sc_2$ in region usually occupied by stigma. Venation: Rs angulated at origin; R_{2+3+4} longer than R_3; R_2 just beyond fork of R_{2+3+4}, a trifle shorter than R_{1+2}; m-cu shortly beyond fork of M, subequal to or a trifle shorter than the distal section of Cu_1.

Abdomen dark brown, the genitalia obscure brownish yellow. Ovipositor with short fleshy valves, the hypovalvæ exceeding the small cerci.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, altitude 4,000 feet, August 13, 1931 (*Franck*).

By Edwards's key to the Old World species of the subgenus, *Hexatoma* (*Eriocera*) *subpusilla* runs to the African *H.* (*E.*) *pusilla* (Alexander). It is quite different from *H.* (*E.*) *luteicostalis* sp. nov. in the reduction in number of antennal segments, the unbrightened costal region, entire lack of a stigmal area, and, especially, the details of venation, as the brevity of R_{2+3}, shortness of cell R_3, and the basal position of m-cu. From *H.* (*E.*) *nudivena* sp. nov. it differs in the small size, much paler wings, and the details of venation.

HEXATOMA (ERIOCERA) KARIYAI sp. nov. Plate 1, fig. 21; Plate 2, figs. 34 to 36.

Belongs to the *rubrescens* group; general coloration black, gray pruinose; antennæ short in both sexes; wings heavily patterned with dark brown, including cells C and Sc and broad seams along cord and longitudinal veins; Rs in alignment with R_5; male hypopygium with a conspicuous hairy tubercle on either side of midline of caudal margin of eighth sternite; ædeagus at apex split into two slender fimbriate arms.

Male.—Length, about 16 to 17 millimeters; wing, 12 by 3.9; antenna, about 3.

Female.—Length, about 25 millimeters; wing, 15 by 5.

Described from alcoholic specimens.

Rostrum and palpi black. Antennæ of male 7-segmented, of female, 11-segmented, black throughout; flagellar segments (male) gradually decreasing in length and diameter to end; in female, terminal segment about as long as the two preceding segments combined; flagellar segments with long coarse black setæ. Head black, with conspicuous black setæ.

Thorax, including halteres, black, in female apparently more grayish pruinose. Legs black, the femoral bases very broadly more yellowish brown or brown, very extensively so on the posterior legs where only the distal sixth is blackened, on forelegs with the outer fifth blackened. Wings (Plate 1, fig. 21) broad, especially in female; ground color brownish yellow, heavily patterned with blackish, including cells C and Sc, prearcular region, and stigma; other large seams include origin of Rs, cord, outer end of cell 1st M_2, and most longitudinal veins, excepting Cu; anal cells streaked with dusky; veins brown. Macrotrichia of veins very sparse, with a restricted series on outer section of R_5. Venation: Rs in alignment with the basal section of R_5, R_{2+3+4} departing at a strong angle, the fork thus asymmetrical; cell 1st M_2 elongate, equal to distal section of M_{1+2}, the other outer branches of M progressively shorter; m-cu one-half to one-third longer than the distal section of Cu_1.

Abdomen black, with a gray pruinosity, most evident in female. Male hypopygium (Plate 2, fig. 34) with the ædeagus, *a*, relatively long, at apex split into two delicately fringed branches. Eighth sternite, 8*s*, with two closely applied submedian tubercles that are densely set with long coarse setæ. Ovipositor about intermediate in structure between the elongate sclerotized and shorter fleshy types; cerci black, elongate, yet not highly polished; hypovalval plate single, at apex split into two paler setiferous lobes.

Habitat.—Japan (Honshiu).

Holotype, alcoholic male, Gifu, Mino, May 17, 1931 (*Kariya*). Allotopotype, alcoholic female. Paratopotype, alcoholic male.

Hexatoma (*Eriocera*) *kariyai* is named in honor of Prof. S. Kariya, entomologist of the Nawa Entomological Laboratory, to whom I am indebted for many Tipulidæ from Mino Province. The species is closest to *H.* (*E.*) *kamiyai* (Alexander) and *H.* (*E.*) *subrectangularis* (Alexander), both of Japan, in the general pattern of the wings, including the darkened costal border, differing in the large size and structure of the male hypopygium. The coloration in alcohol is distinctly pruinose, and if this is a natural condition, the fly is very different from *kamiyai* in which the entire body is intense velvet-black. The ædeagi of the male hypopygia of *kamiyai* (Plate 2, fig. 35, *a*, holotype) and *subrectangularis* (Plate 2, fig. 36, *a*, paratype) are shown for comparison with the present fly.

HEXATOMA (ERIOCERA) PLESKEI sp. nov. Plate 1, fig. 22.

Belongs to the *rubrescens* group; general coloration black, the præscutum light gray, with four more blackish gray stripes; antennæ short in both sexes; legs and halteres black; wings with a strong yellowish brown tinge, the cord a little clouded with darker; macrotrichia of veins beyond cord very sparse; abdomen dull black, sparsely pruinose.

Male.—Length, 12 to 14 millimeters; wing, 12 to 13.

Female.—Length, 15 to 16 millimeters; wing, 12 to 14.

Rostrum and palpi black. Antennæ short in both sexes, black throughout, 7-segmented in male, 11-segmented in female. Head brownish gray, the vertical tubercle clearer gray, relatively small in both sexes, in male weakly notched; head with abundant long black setæ.

Mesonotum light gray, the præscutum with four more blackish gray stripes; setæ relatively long, dark-colored; scutum with centers of lobes extensively darkened. Pleura black, pruinose. Halteres black. Legs with the coxæ and trochanters black, pruinose; remainder of legs black. Wings (Plate 1, fig. 22) with a strong yellowish brown tinge, the costal region a little darker; stigma small, oval, dark brown; a scarcely apparent darker brown cloud along cord; veins dark brown. Macrotrichia of veins beyond cord very sparse or lacking, with a scattered series of about ten relatively long trichia on distal section of vein R_5. Venation: R_{2+3} more than twice R_{2+3+4} and about two-thirds to

three-fourths R_3 alone; cell M_1 lacking; m-cu near midlength of cell 1st M_2.

Abdomen, including hypopygium, dull black, very sparsely pruinose; extreme bases of tergites and the subbasal impressed transverse lines narrowly polished black. Ovipositor black throughout; cerci sclerotized, slender, the tips obtuse.

Habitat.—Eastern Siberia (Ussuri).

Holotype, male, Tigrowaja, Suchan district, June 16, 1927 (*Stackelberg*). Allotopotype, female, June 11, 1927. Paratopotypes, 5 males and females, June 8 to 16, 1927; paratypes, 1 male, 1 female, Sedanka River, near Wladiwostok, April 20, 1927 (*Martynov*).

I take great pleasure in dedicating this distinct *Eriocera* to Dr. Theodore Pleske, distinguished dipterologist and ornithologist, to whom I express my indebtedness for many kindly favors. Among the regional species of the group, the only other with entirely black legs is *Hexatoma* (*Eriocera*) *longifurca* (Alexander), of Japan, which differs conspicuously from the present fly in the more yellowish wings that are conspicuously variegated with brown, and in the more grayish pruinosity covering the entire body.

HEXATOMA (ERIOCERA) PYRRHOPYGA sp. nov. Plate 1, fig. 23; Plate 2, fig. 37.

Belongs to the *mesopyrrha* group; mesonotal præscutum deep reddish brown with three dark brown stripes; remainder of notum and pleura dark liver brown; femora yellow, the tips black, narrowest on fore and middle femora, more broadly so on posterior legs; wings with the ground color brown, the base and a broad diffuse band before cord yellow; distal half of cell C dark brown; costa nearly glabrous, as in group; abdomen with segments two to four orange, five to seven black, eight and nine reddish yellow.

Male.—Length, about 18 to 22 millimeters; wing, 17 to 21; antenna, 4.8 to 5.2.

Rostrum and palpi dark brown. Antennæ (male) 7-segmented; scape and pedicel dark brown, flagellum yellow throughout; flagellar segments gradually decreasing in length and size outwardly, the black verticils long and conspicuous. Head dark brownish gray; vertical tubercle of moderate size, entire, with black setæ.

Ground color of mesonotal præscutum deep reddish brown, restricted by three dark brown stripes; posterior sclerites of notum and pleura deep liver-brown to dark brown. Halteres

dark brown. Legs with the coxæ and trochanters brownish black; femora yellow basally, the tips conspicuously blackened, very narrowly so on fore and middle legs where the distal fifth or sixth is included, much broader on the posterior legs where the distal two-thirds or more is blackened; tibiæ obscure yellow to brownish yellow, the tips narrowly brownish black; tarsi brownish black. Wings (Plate 1, fig. 23) with the ground color brown, the costal region orange, the distal half of cell C abruptly dark brown; a broad diffuse yellow crossband before cord; prearcular region yellow; veins brown, yellow in the flavous areas. Trichiation about as in other members of the group, the costal series very sparse; trichia on veins R_{1+2}, R_3, R_4, and R_5 beyond cord. Venation: R_{1+2} very long, subequal to or exceeding twice m-cu.

Abdomen with basal segment brownish black, segments two to four orange, the tergites margined posteriorly with black, more broadly so on fourth segment; segments five to seven black; outer segments, including hypopygium, reddish yellow. Male hypopygium (Plate 2, fig. 37) with the outer dististyle glabrous, the surface with oblique parallel striæ or wrinkles, apical notch distinct, terminal spine slender and decurved; gonapophyses bifid.

Habitat.—China (Fukien).

Holotype, male, Foochow (*Kellogg*). Paratopotypes, 2 males.

Hexatoma (*Eriocera*) *pyrrhopyga* is allied to the regional *H.* (*E.*) *kelloggi* (Alexander), *H.* (*E.*) *muiri* (Alexander), and *H.* (*E.*) *prælata* (Alexander), differing from all in the reddish yellow hypopygium, which contrasts conspicuously with the black subterminal abdominal segments. In the general coloration of the body, the fly comes closest to *prælata*, being entirely different from the two other species above listed; *H.* (*E.*) *cæsarea* (Alexander) likewise belongs to this group, but is readily distinguished from the other members by the lack of a pale crossband on the wing disk.

HEXATOMA (ERIOCERA) CLEOPATRA sp. nov. Plate 1, fig. 24.

Belongs to the *dichroa* group; thorax brownish black or black; antennal flagellum reddish brown; legs dark brown; wings with a strong brownish yellow tinge, with a broad but very poorly defined more yellowish band before cord; cells C and Sc not darkened; costa with very numerous small trichia; veins beyond cord with trichia; cell M_1 present; abdominal segments one and five to seven black, the remainder orange.

Female.—Length, about 27 millimeters; wing, 21.

Rostrum and palpi dark brown. Antennæ with the scape dark brown, succeeding three segments more reddish brown, terminal segments broken; verticils conspicuous, black. Head blackish gray; vertical tubercle small and simple.

Thorax almost entirely very dark brownish black or black, the extreme cephalic portion of præscutum variegated by reddish on either side of a capillary dark median vitta; thoracic setæ black. Halteres reddish brown, the knobs dark brown. Legs with the coxæ and trochanters black; remainder of legs very dark brown. Wings (Plate 1, fig. 24) with a strong brownish yellow tinge; a broad but very poorly defined, more yellowish band before cord; cells C and Sc not darker than the ground; veins chiefly yellow. Macrotrichia of costa very numerous but short; macrotrichia on veins beyond cord, including complete series on $R_1 + Sc_2$, R_{1+2}, R_{2+3+4}, R_{2+3}, R_3, R_4, and both sections of R_5; on outer medial veins trichia are present but more scattered; a few on distal two-thirds of Rs. Venation: Sc long, Sc_2 ending beyond R_2; R_{2+3+4} one-half longer than basal section of R_5; R_2 slightly oblique; R_{1+2} from one-third to one-half longer than R_{2+3}; cell M_1 present.

Abdomen with basal tergite black, the caudal margin narrowly orange; segments two to four, inclusive, orange, the pleural membrane darkened; segments five to seven black; eighth segment and shield of ovipositor bright orange; valves elongate, horn-yellow.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, altitude 7,000 feet, August 11, 1931 (*Franck*).

By Edwards's key to the Old World species of *Eriocera* [5] this fly runs to couplet 42, beyond which point it disagrees with all included members in the yellowish wings and coloration of antennæ. If the unusually diffuse band on the wings is considered as being distinct, the fly runs further to couplet 86, including *bicolor* (Macquart) and *cingulata* (de Meijere), which are very different species. In its general appearance, the present fly is much like certain members of the *mesopyrrha* group, notably *cæsarea* (Alexander); but the presence of abundant costal trichia and undarkened costal region serve to separate the two species.

[5] Ann. & Mag. Nat. Hist. IX 8 (1921) 70–78.

ILLUSTRATIONS

[*a*, Ædeagus; *b*, basistyle; *g*, gonapophysis; *i*, interbase; *id*, inner dististyle; *od*, outer dististyle; *p*, phallosome; *s*, sternite; *t*, tergite.]

PLATE 1

FIG. 1. *Tipula* (*Acutipula*) *oncerodes* sp. nov., venation.
2. *Tipula* (*Acutipula*) *latifasciata* sp. nov., venation.
3. *Tipula amytis* sp. nov., venation.
4. *Tipula vitiosa* sp. nov., venation.
5. *Tipula vivax* sp. nov., venation.
6. *Pseudolimnophila brunneinota* sp. nov., venation.
7. *Limnophila* (*Idioptera*) *ussuriana* sp. nov., venation.
8. *Limnophila* (*Dicranophragma*) *melaleuca* sp. nov., venation.
9. *Limnophila* (*Dicranophragma*) *lætithorax* sp. nov., venation.
10. *Limnophila martynovi* sp. nov., venation.
11. *Hexatoma* (*Eriocera*) *lanigera* sp. nov., venation.
12. *Hexatoma* (*Eriocera*) *tibetana* sp. nov., venation.
13. *Hexatoma* (*Eriocera*) *mediofila* sp. nov., venation.
14. *Hexatoma* (*Eriocera*) *stackelbergi* sp. nov., venation.
15. *Hexatoma* (*Eriocera*) *gifuensis* sp. nov., venation.
16. *Hexatoma* (*Eriocera*) *verticalis* (Wiedemann), venation.
17. *Hexatoma* (*Eriocera*) *omeiana* sp. nov., venation.
18. *Hexatoma* (*Eriocera*) *luteicostalis* sp. nov., venation.
19. *Hexatoma* (*Eriocera*) *nudivena* sp. nov., venation.
20. *Hexatoma* (*Eriocera*) *subpusilla* sp. nov., venation.
21. *Hexatoma* (*Eriocera*) *kariyai* sp. nov., venation.
22. *Hexatoma* (*Eriocera*) *pleskei* sp. nov., venation.
23. *Hexatoma* (*Eriocera*) *pyrrhopyga* sp. nov., venation.
24. *Hexatoma* (*Eriocera*) *cleopatra* sp. nov., venation.

PLATE 2

FIG. 25. *Tipula* (*Acutipula*) *bipenicillata* Alexander, male hypopygium, details.
26. *Tipula* (*Acutipula*) *desidiosa* sp. nov., male hypopygium, details.
27. *Tipula* (*Acutipula*) *oncerodes* sp. nov., male hypopygium, details.
28. *Tipula* (*Indotipula*) *subyamata* sp. nov., male hypopygium, details.
29. *Tipula* (*Indotipula*) *yamata* Alexander, male hypopygium, details.
30. *Pseudolimnophila brunneinota* sp. nov., male hypopygium.
31. *Limnophila* (*Idioptera*) *ussuriana* sp. nov., male hypopygium.
32. *Limnophila* (*Dicranophragma*) *lætithorax* sp. nov., male hypopygium.

FIG. 33. *Hexatoma* (*Eriocera*) *gifuensis* sp. nov., male hypopygium.
34. *Hexatoma* (*Eriocera*) *kariyai* sp. nov., male hypopygium.
35. *Hexatoma* (*Eriocera*) *kamiyai* (Alexander), male hypopygium, ædeagus.
36. *Hexatoma* (*Eriocera*) *subrectangularis* (Alexander), male hypopygium, ædeagus.
37. *Hexatoma* (*Eriocera*) *pyrrhopyga* sp. nov., male hypopygium.

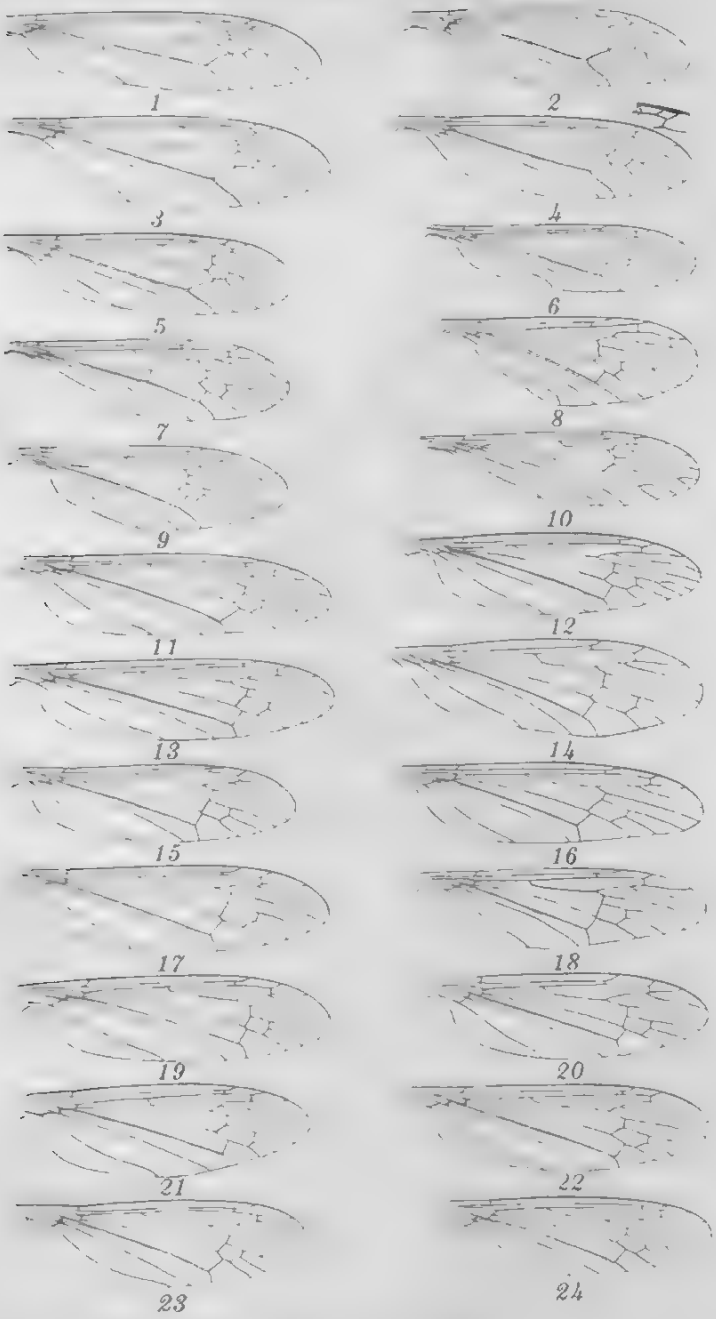


PLATE 1.

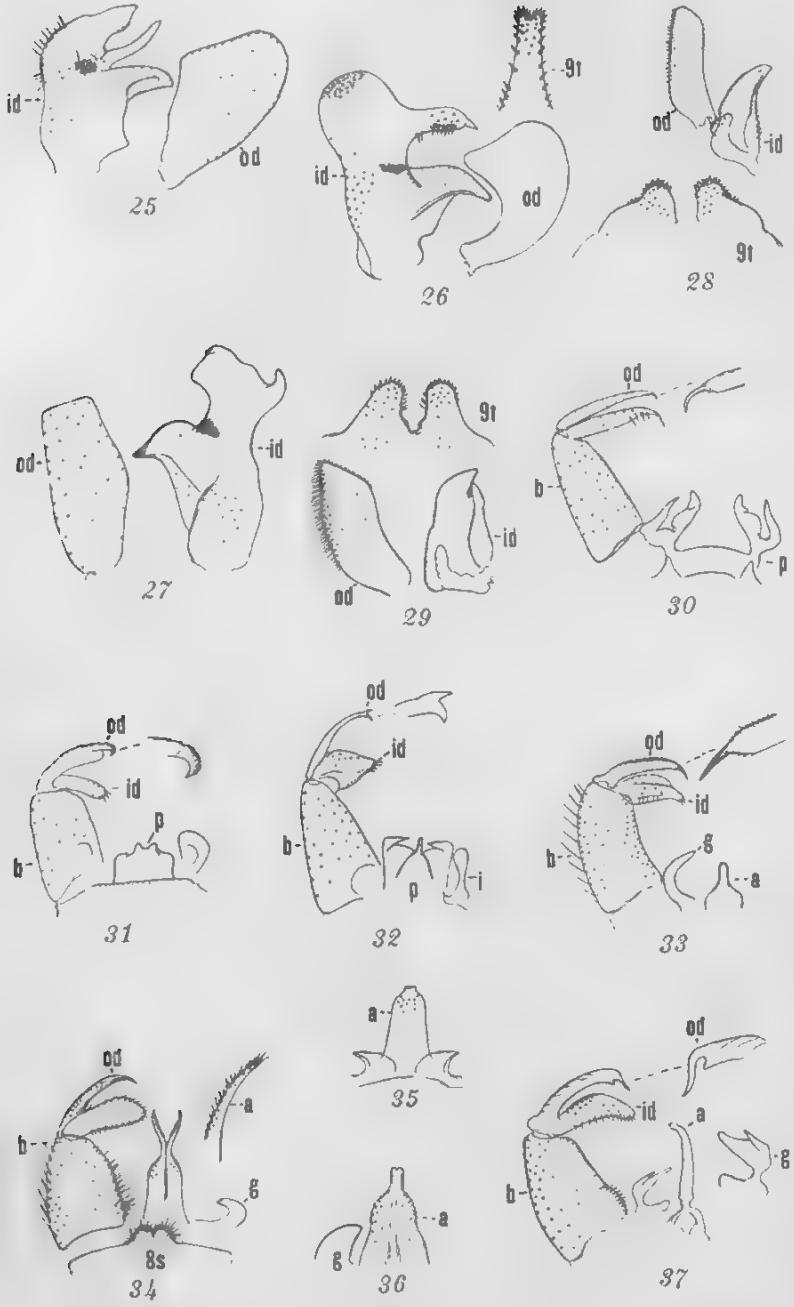

id
od
25
9t
id
od
26
od
id
9t
28
od
id
27
9t
id
od
29
od
b
p
30
od
id
p
b
31
od
id
b
p
i
32
od
id
g
b
a
33
a
35
od
a
b
g
8s
34
a
g
36
od
id
a
g
b
37

PLATE 2.

TREMATODE PARASITES OF PHILIPPINE VERTEBRATES, VI

DESCRIPTIONS OF NEW SPECIES AND CLASSIFICATION

By MARCOS A. TUBANGUI

Of the Division of Biology and Serum Laboratory, Bureau of Science, Manila

SIX PLATES

In this paper, which constitutes the sixth of a series dealing with the trematode fauna of Philippine vertebrates, it has been decided to include among others the descriptions of several parasites that are represented in our collection by single mounted specimens. Many of these have been kept for several years, with the hope that additional material would come to hand. Now they are named and described with no further delay.

DESCRIPTIONS

DIPLODISCUS AMPHICHRUS sp. nov. Plate 1, figs. 1 and 2.

The material consists of two sets of specimens collected from frogs: three small, young adults from the small intestine and five large, fully mature forms from the rectum. Due to differences in size, shape, and habitat the two sets of specimens were considered in the beginning to represent distinct species. A comparison of their important characters, however, such as the degree of development of the pharyngeal pockets and œsophageal bulb, the distribution of the vitelline glands, the presence of one testis, the position of the genital pore and the posterior extent of the intestinal cæca, has shown that they are identical.

In his recent revision of the amphistomatous flukes, Fukui (1929) recognizes four species in the genus *Diplodiscus* Diesing: namely, *D. subclavatus* (Goeze, 1782), *D. cornu* (Diesing, 1840), *D. temperatus* Stafford, 1906, and *D. americanus* (Chandler, 1923). To these should be added three other species; but, according to Hardwood (1932), only *D. intermedius* Hunter, 1930, is valid, the other two (*Opisthodiscus americanus* Holl, 1928, and *Megalodiscus ranophilus* Millzner, 1924) being considered as synonyms of *D. temperatus*. Fuhrmann (1928), Fukui, and

others also consider Chandler's genus *Megalodiscus* as identical with *Diplodiscus*, but according to Hardwood it should be retained to include the American representatives of the subfamily Diplodiscinæ.

The present form appears to be most closely related to *D. subclavatus*, especially, in the possession of a single testis and in the degree of development of the vitelline glands. It differs from it in the small size of its eggs and, above all, in the position of its genital pore and cirrus sac, which lie some distance behind the œsophageal bifurcation, and in the fact that the vitelline glands meet anteriorly in the median line.

Description.—Body conical, circular or oval in cross-section depending upon state of contraction and method of killing; measures 1.6 to 3.3 millimeters in length by 0.6 to 0.86 millimeter in maximum diameter. Cuticle smooth. Oral sucker ventro-antero-terminal, 0.11 to 0.26 by 0.10 to 0.32 millimeter in size. Oral diverticula (pharyngeal pockets) arise from posterodorsal wall of oral sucker and extend posteriorly; they possess a common medial wall and each is as long as the oral sucker. Œsophagus 0.27 to 0.44 millimeter long, double-walled, passes ventral to pharyngeal pockets and posteriorly it enlarges somewhat to form an inconspicuous bulb. Intestinal cæca simple, moderately wide in diameter, extend to as far as anterior border of posterior sucker, sometimes slightly in front or beyond that level. Posterior sucker posteroterminal, well developed, 0.50 to 1.08 millimeters across, depending upon state of contraction; it presents in its center a small suckerlike structure, measuring 0.10 by 0.13 millimeter across.

Only a single testis is present; it is roundish or slightly oval, median, preovarial, equatorial, 0.14 to 0.46 by 0.12 to 0.46 millimeter in size. Cirrus sac small, oval, 0.12 to 0.22 by 0.10 to 0.14 millimeter in size. Genital pore median, immediately behind anterior third of body length, 0.13 to 0.5 millimeter behind œsophageal bifurcation.

Ovary relatively small, oval, to one side of median line, immediately posttesticular, 0.12 to 0.24 by 0.10 to 0.21 millimeter in size. Shell gland and oötype median, behind ovary; Laurer's canal present, opens dorsally opposite ovary. Uterus short to moderately long, confined between cæca and vitelline glands. Vitellaria in large distinct follicles, lateral and ventral to intestinal cæca, extending from level of œsophageal bulb (in some young specimens sometimes from immediately behind oral diverticula) to posterior sucker or in front of that level. The vitelline

follicles meet in the median line both anteriorly and posteriorly; that is, in front of genital pore and behind ovary, sometimes crowding out the latter. Eggs few to many, oval, yellowish, thin-shelled, operculated, 104 to 112 by 62.4 to 70.7 microns in size.

Excretory vesicle median, immediately or a short distance in front of posterior sucker; excretory pore opens dorsally at about the same level. The lymph system could not be made out in detail. In some of the preparations, however, there are distinctly visible two ventral longitudinal vessels on each side of the body, which take a more or less zigzag cephalic course starting from in front of the excretory vesicle. They seem to arise from a short median longitudinal trunk and on reaching the level immediately behind the oral diverticula each vessel makes a sharp bend and is continued posteriorly as a dorsal vessel.

Specific diagnosis.—Diplodiscus: Body conical, 1.6 to 3.3 by 0.6 to 0.86 millimeters in size. Testis single, roundish to oval, median, equatorial, 0.14 to 0.46 by 0.12 to 0.46 millimeter in size. Œsophagus 0.27 to 0.44 millimeter long, with an inconspicuous posterior bulb. Genital pore behind anterior third of body length, some distance behind œsophageal bifurcation. Vitellaria well developed, from level of œsophageal bulb, sometimes from behind oral diverticula, to posterior sucker or in front of that level; vitelline follicles of two sides meet in median line both anteriorly and posteriorly. Eggs 104 to 112 by 62.4 to 70.7 microns in size.

Hosts.—Frogs (*Rana* spp.).

Locations.—Usually rectum; rarely small intestine.

Localities.—Los Baños, Laguna Province (type locality); Novaliches, Rizal Province; and Manila, P. I.

Type specimens.—Philippine Bureau of Science parasitological collection No. 383.

NEPHROSTOMUM BICOLANUM sp. nov. Plate 2, figs. 1 and 2.

Numerous specimens of this fluke were obtained on several occasions from the small intestines of two kinds of egrets. The worm is similar in many respects to *Nephrostomum ramosum* (Sonsino, 1895), as described by Dietz (1910) and by Odhner (1910), differing only from the European species in the absence of a shallow inlet or depression ("Einbuchtung") on the dorsal or anterior border of the cephalic collar and in the relative sizes of the collar spines, especially the innermost corner ones, which in many specimens are very small or degenerate.

Description.—Body elongate, slightly tapering toward both extremities, 8.10 to 15.15 millimeters in length by 1.40 to 2.40 millimeters in maximum breadth across genital organs; anterior region separated from rest of body by slight constriction at level of acetabulum, its lateral margins inrolled ventrally. Cuticle smooth. Cephalic collar reniform, rounded dorsally, that is without dorsal depression, 1.08 to 1.40 millimeters across, carrying forty-seven blunt spines arranged peripherally in one row uninterrupted dorsally. Four to five corner ventral spines on each side of collar often bunched together and measure 41 to 58 by 16.6 to 33.2 microns; in many specimens, however, some of these spines, at least the first two or three innermost ones on one or both sides, are much reduced and measure only 16.6 to 25 by 12.5 to 20.8 microns; the lateral spines, eleven to twelve in number, are the largest, 45.7 to 62.5 by 29.1 to 37.5 microns; dorsal spines 33.2 to 45.7 by 16.6 to 29.1 microns. Oral sucker ventroterminal, 0.26 to 0.28 by 0.28 to 0.36 millimeter in size; pharynx 0.24 by 0.22 to 0.24 millimeter; œsophagus 0.32 to 0.56 millimeter long, bifurcates in front of acetabulum; intestinal cæca simple, reach to near posterior end of body. Acetabulum 1.04 to 1.54 millimeters from anterior end and measures 1.04 to 1.34 by 1.10 to 1.44 millimeters.

Testes relatively small, tandem, postovarial, four- to six-lobed, 0.46 to 1.44 by 0.32 to 0.66 millimeters in size. Cirrus sac oval, 0.36 to 0.56 by 0.30 to 0.38 millimeter, its greater bulk in front of anterior border of acetabulum; incloses vesicula seminalis, pars prostatica, and cirrus. Genital pore median, preacetabular, immediately behind œsophageal bifurcation.

Ovary median, at or near middle of body length, 0.24 to 0.54 by 0.30 to 0.64 millimeter in size, its surface smooth or slightly indented; oviduct arises from its posterior border. Oötype complex median, behind and contiguous to ovary; shell gland as large as ovary or larger. Receptaculum seminis absent, Laurer's canal present. Uterus moderately to very long, in closely packed coils between ovary and acetabulum. Vitellaria lateral, mostly extracæcal, extend from slightly behind acetabulum to near posterior end of body or as far as blind terminations of intestinal cæca; vitelline follicles of two sides do not unite behind second testis. Eggs oval, yellowish, thin-shelled, operculated, 95.5 to 104 by 60 to 62 microns in size.

Excretory pore median, posterodorsal; excretory bladder long, with several pairs of lateral branches, divides into two main branches a short distance behind second testis.

Specific diagnosis.—Nephrostomum: Body 8.10 to 15.15 by 1.40 to 2.40 millimeters in size. Head collar 1.08 to 1.40 millimeters across, without dorsal depression, armed with forty-seven blunt spines. Four to five corner ventral spines on each side of collar often bunched together, measure 41 to 58 by 16.6 to 33.2 microns; sometimes they are much reduced, at least the first two or three on one or both sides, and measure only 16.6 to 25 by 12.5 to 20.8 microns; lateral spines 45.7 to 62.5 by 29.1 to 37.5, dorsal spines 33.2 to 45.7 by 16.6 to 29.1 microns. Eggs 95.5 to 104 by 60 to 62 microns in size.

Hosts.—Herodias timoriensis (type host) and *Bubulcus coromandus.*

Location.—Small intestine.

Locality.—Iriga, Camarines Sur, Luzon (type locality), and Palo, Leyte.

Type specimens.—Philippine Bureau of Science parasitological collection No. 317; paratypes No. 369.

ACANTHOPARYPHIUM OCHTHODROMI sp. nov. Plate 2, figs. 3 and 4.

Sixteen specimens of this echinostome were collected from the small intestines of two plover birds. The parasite differs from *Acanthoparyphium phoenicopteri* (Luehe, 1898), the type species of the genus, as described by Dietz (1910), in being more elongate, its collar spines smaller, the cirrus pouch longer, the acetabulum between the first and second fourth of the body length, the eggs larger, and the vitelline glands extending anteriorly near the level of the acetabulum. It may also be distinguished from *A. spinulosum* Johnston, 1916, by the anterior extent of its vitellaria, its smaller collar spines, its larger eggs, and the posterior extent of its cirrus sac which does not reach to the level of the ovary.

Description.—Body elongate, more pointed posteriorly than anteriorly, usually slightly constricted at level of acetabulum; measures 3.90 to 5.40 millimeters in length by 0.70 to 0.90 millimeter in maximum breadth across ovary or in front of that level. Cuticle armed with prominent spines from anterior end behind head collar to acetabulum. Oral sucker anterosubterminal, 0.09 to 0.14 by 0.10 to 0.14 millimeter in size, surrounded by head collar. Latter reniform, 0.30 to 0.37 millimeter across, provided with twenty-three spines arranged peripherally in single row uninterrupted dorsally. The two innermost ventral corner spines of the head collar are the smallest of the series, reaching a maximum size of only 29 by 8.5 microns; the next three or

four spines on each side are the largest, measuring 45 to 58.2 by 9 to 12.5 microns; the rest of the collar spines measure 30 to 41.5 by 9 to 10.5 microns. Oral sucker followed by prepharynx 0.03 to 0.05 millimeter long; pharynx 0.08 to 0.12 by 0.06 to 0.11 millimeter in size; œsophagus 0.32 to 0.66 millimeter long, bifurcates in front of acetabulum; cæca simple, narrow in diameter, reach to near posterior end of body. Acetabulum 0.34 to 0.44 by 0.35 to 0.42 millimeter in size, between first and second fourth of body length.

Testes tandem, postovarial, roundish to oval in outline, 0.44 to 0.64 by 0.42 to 0.62 millimeter in size; surface smooth in some of the younger specimens, in older ones more or less deeply notched so that each organ appears three- to six-lobed. Cirrus sac shaped like a bottle with a long neck, 0.75 to 0.92 by 0.12 to 0.14 millimeter, one-third to one-half of its length reaching posteriorly behind acetabulum; incloses seminal vesicle, pars prostatica and protrusible cirrus. Common genital pore median, preacetabular, immediately behind or almost ventral to œsophageal bifurcation.

Ovary slightly compressed or globular, 0.14 to 0.17 by 0.16 to 0.17 millimeter in size, in front of middle of body length, slightly to one side of median line. Shell gland, which is larger than ovary, and the rest of the oötype complex between ovary and anterior testis; receptaculum seminis absent, Laurer's canal present. Uterus short to moderately long, mostly preovarial. Vitellaria mostly lateral and extracæcal, from behind acetabulum to as far as blind ends of intestinal cæca or slightly behind that level; vitelline follicles of two sides unite behind testis or at most are separated only by a narrow space. Eggs oval, yellowish, thin-shelled, operculated, 104 to 116 by 62 to 70 microns in size.

Excretory pore posteroterminal; excretory bladder long, divides into two branches behind second testis.

Specific diagnosis.—Acanthoparyphium: Body 3.90 to 5.40 by 0.70 to 0.90 millimeters, usually constricted at level of acetabulum. Acetabulum 0.34 to 0.44 by 0.35 to 0.42 millimeter, between first and second fourth of body length. Cephalic collar 0.30 to 0.37 millimeter across; innermost ventral corner spines are 29 by 8.5 microns in maximum size, other corner spines 45 to 58.2 by 9 to 12.5, rest of spines 30 to 41.6 by 9 to 10.5 microns. Testes usually three- to six-lobed. Cirrus sac 0.75 to 0.92 by 0.12 to 0.14 millimeter, its posterior end far from ovary. Vitellaria from behind acetabulum to near posterior end of body. Eggs 104 to 116 by 62 to 70 microns in size.

Host.—*Ochthodromus mongolus.*

Location.—Small intestine.

Locality.—Palo, Leyte.

Type specimens.—Philippine Bureau of Science parasitological collection No. 362.

CERCORCHIS CYCLEMIDIS sp. nov. Plate 3, fig. 2.

Only one specimen of this parasite is available for description. It was collected from a turtle and was well preserved for staining. Compared with the already known members of the genus *Cercorchis* Luehe, 1900, as listed and differentiated by Perkins (1928) as well as with those recently described by Hardwood (1932), it appears to be most closely allied to *C. corti* (Stunkard, 1916) and to *C. texanus* Hardwood. It differs from the former, however, in being slightly larger, with a longer œsophagus, metraterm and cirrus sac, and in the two testes being contiguous and touching each other. It may be distinguished from *C. texanus* by its longer œsophagus and cirrus sac and the extent of its vitelline glands that reach anteriorly much beyond the level of the ovary and posteriorly far from the anterior testis.

Description.—Body elongate, tapering slightly towards both extremities, 8.3 millimeters in length by 0.66 millimeter in maximum breadth across any level touching vitelline glands. Cuticle armed with prominent spines from anterior end to near posterior end of body beyond level of second testis. Oral sucker anterosubterminal, smaller than acetabulum, 0.11 by 0.13 millimeter in size; prepharynx absent; pharynx 0.07 by 0.08 millimeter in size; œsophagus 0.30 millimeter long; intestinal cæca simple, reach to near posterior end of body. Acetabulum 0.16 millimeter across, near middle of anterior third of body length or 1.3 millimeters from anterior end.

Testes oval, postovarial, one immediately behind the other and slightly touching, the distance between the posterior end of the body and the posterior border of the second testis being equal to the length of this latter organ; they are separated from the ovary by the greater bulk of uterine coils. The anterior testis measures 0.34 by 0.29 and the posterior testis 0.36 by 0.27 millimeter. Cirrus sac very elongate, about 2.0 millimeters long by 0.14 millimeter wide near distal end, separated from ovary by portion of uterus or a distance of nearly 0.5 millimeter; it incloses a small seminal vesicle, pars prostatica and cirrus. Common genital pore almost in median line, near and in front of acetabulum.

Ovary globular, preëquatorial, almost median, 0.24 millimeter in diameter. Shell gland and oötype immediately postovarial; receptaculum seminis not distinct, Laurer's canal present. Vitellaria in granular follicles, not arranged in separate groups as in many of the members of the genus and have the tendency to pass towards the median line across the intestinal cæca; they extend from about one-third of the distance from the ovary to the acetabulum, in front of posterior end of cirrus sac, to 1.9 millimeters behind posterior border of ovary; the vitelline glands on the left side extend slightly farther anteriorly and posteriorly than those of opposite side. Uterine coils confined between cæca, arranged in two distinct sets, the right descending and left ascending coils; they reach posteriorly almost to the anterior testis and anteriorly to the middle of the length of the cirrus sac. The metraterm is slightly wavy in outline and is nearly one-half as long as the cirrus sac. Ova in distal portion of uterus small, brown, operculated, 31.5 to 33.2 by 18.5 to 20.0 microns in size.

Excretory system typical; excretory pore posteroterminal; excretory bladder long, reaches anteriorly to level of ovary where it divides into two branches.

Specific diagnosis.—Cercorchis: Size 8.3 by 0.66 millimeters; cuticle armed with spines from anterior end to near posterior end of body. Oral sucker slightly smaller than acetabulum; prepharynx absent, œsophagus 0.30 millimeter long. Cirrus sac 2.0 millimeters long, metraterm nearly one-half as long. Testes touching. Vitellaria with tendency to pass across cæca, not arranged in separate groups, extend from in front of level of posterior end of cirrus sac to a distance of 1.9 millimeters behind ovary. Descending and ascending coils of uterus distinct. Ova 31.5 to 33.2 by 18.5 to 20.0 microns in size.

Host.—Cyclemis amboinensis (Daudin).

Location.—Intestine.

Locality.—Novaliches, Rizal, Luzon.

Type specimen.—Philippine Bureau of Science parasitological collection No. 406 (stained, mounted).

PARADISTOMUM PALOENSIS sp. nov. Plate 4, fig. 2.

The material available consists of a single specimen which was partially damaged during the process of killing. It may be separated from the very closely related Philippine species, *Paradistomum gregarinum* (Tubangui, 1929), by its larger body dimensions and its very short œsophagus.

Description.—Body more or less ovoid, narrower anteriorly than posteriorly, 4.75 millimeters in length by 2.43 millimeters in maximum breadth across equator. Cuticle smooth. Oral sucker subterminal, 0.38 by 0.48 millimeter in size; pharynx 0.16 by 0.20 millimeter; œsophagus very short, practically absent; intestinal cæca very much dilated, extend to about 0.45 millimeter from posterior end of body. Acetabulum between anterior and middle thirds of body length, 0.44 by 0.48 millimeter in size.

Testes oval, symmetrical, immediately postacetabular and preovarial; right testis measures 0.30 by 0.46, left testis 0.34 by 0.46 millimeter. Cirrus sac ventral to œsophageal bifurcation, 0.40 by 0.12 millimeter in size; incloses small seminal vesicle, pars prostatica, and cirrus. Common genital pore median, behind pharynx.

Ovary ovoid, with slightly indented surface, near median line, preëquatorial, 0.34 y 0.26 millimeter in size. Shell gland, which is larger than ovary, and rest of oötype complex median, behind ovary. Uterus mostly behind genital glands; it was ruptured, however, during the process of killing the specimen so that the arrangement of its coils could not be made out. Vitellaria follicular, lateral to intestinal cæca, occupy middle thirds of body length. Eggs small, yellowish to dark brown, operculated, 33 to 37 by 25 microns in size.

Excretory pore posterodorsal.

Specific diagnosis.—Paradistomum: Length 4.75, maximum breadth across middle 2.43 millimeters. Cuticle smooth. Œsophagus very short, practically absent. Genital pore immediately postpharyngeal. Eggs 33 to 37 by 25 microns in size.

Host.—Hydrosaurus pustulosus (Eschscholtz).

Location.—Gall bladder.

Locality.—Palo, Leyte.

Type specimen.—Philippine Bureau of Science parasitological collection No. 393.

STYPHLODORA RENALIS sp. nov. Plate 4, fig. 4.

Numerous specimens of this fluke were collected from the kidney of a python by Dr. Candido Africa, of the School of Hygiene and Public Health, University of the Philippines. I am indebted to Doctor Africa for the opportunity to study them.

Compared with the other members of the genus *Styphlodora* this parasite appears to be most closely related to *S. serrata* Looss, 1899, especially in the arrangement of the ovary and testes and in the extent and poor development of the vitelline

glands. The two species differ, however, in the length of the œsophagus, that of *S. renalis* being very short or practically absent; and in the position of the acetabulum, that of *S. serrata* being located between the anterior and middle thirds of the body length and that of *S. renalis* in the middle of the anterior third of the body length.

Description.—Body small, oval to elongate, broader posteriorly than anteriorly, 2.3 to 4.6 by 0.95 to 1.7 millimeters in size. Cuticle armed with spines from anterior end to near posterior end of body. Oral sucker subterminal to ventroterminal, 0.18 to 0.24 by 0.20 to 0.28 millimeter in size; prepharynx absent; pharynx 0.14 to 0.20 by 0.10 to 0.16 millimeter; œsophagus very short, practically absent; intestinal cæca simple, do not reach near posterior end of body, in the majority of cases only slightly beyond second third of body length. Acetabulum 0.22 to 0.38 by 0.26 to 0.40 millimeter in size, in middle of anterior third of body length.

Testes round to oval or elongate, postovarial, one obliquely behind the other; their surfaces are rarely smooth, often they are more or less distinctly indented so that each organ may present two to five lobes; they measure 0.34 to 0.52 by 0.17 to 0.35 millimeter. Cirrus sac prominent, 0.40 to 0.64 by 0.14 to 0.20 millimeter in size, extends posteriorly beyond acetabulum to ovary; it incloses vesicula seminalis, pars prostatica and cirrus. Genital pore median, in rare cases slightly to one side of median line, immediately preacetabular.

Ovary oval or triangular with rounded angles, smooth, to one side of median line, a short distance behind acetabulum, 0.20 to 0.24 by 0.18 to 0.19 millimeter in size. Oötype complex median, between ovary and anterior testis; shell gland diffuse, poorly developed. Receptaculum seminis gourd-shaped, behind ovary; Laurer's canal present. Vitellaria follicular, scanty, lateral, extend from level of acetabulum to that of anterior testis. Uterus well developed, arranged in descending and ascending coils that partly overlap, mostly posttesticular, reaching posteriorly beyond blind terminations of intestinal cæca. Eggs numerous, oval, yellowish, thin-shelled, operculated, 45.5 to 47.8 by 20.8 to 22.8 microns in size.

Excretory pore posterodorsal.

Specific diagnosis.—*Styphlodora:* Size 2.3 to 4.6 by 0.95 to 1.7 millimeters. Œsophagus very short, practically absent. Acetabulum 0.22 to 0.38 by 0.26 to 0.40 millimeter, in middle

of anterior third of body. Cirrus sac 0.40 to 0.64 by 0.14 to 0.20 millimeter, reaches posteriorly to middle of ovary. Eggs 45.5 to 47.8 by 20.8 to 22.8 microns in size.

Host.—*Python reticulatus.*

Location.—Kidney.

Locality.—? Manila, P. I.

Type specimens.—Philippine Bureau of Science parasitological collection No. 299.

CLINOSTOMUM DALAGI sp. nov. Plate 4, fig. 1.

Seven immature specimens of this fluke were received for determination from Dr. Zacarias de Jesus, of the College of Veterinary Science, University of the Philippines, Los Baños, who found them encysted in the eye-sockets and on the pericardial wall of a fish. The adult stage of this worm, as well as that of another species found in frogs, which is also described in this paper, will probably be found in the throats of birds, as is the case with related forms reported in other parts of the world (see Osborn, 1912, and Cort, 1913).

The available literature mentions only three young forms of *Clinostomum* that are adequately described and with which the Philippine species may be compared; namely, *C. dictyotum* (Looss, 1885) (= *C. reticulatum*), *C. marginatum* (Rudolphi, 1815), and *C. attenuatum* Cort, 1913. It is at once distinguished from *C. dictyotum* by the presence of lateral branches on the intestinal cæca, the shape of the ovary, and the posterior extent of its uterine sac. From the other two species it can be separated by the shape of its genital glands, the length and shape of the uterine sac, and the relative sizes of its suckers.

Description.—Body elongate oval, narrower anteriorly than posteriorly, 4.20 to 4.45 by 1.85 to 2.20 millimeters in size. Cuticle armed with minute spines from anterior to posterior end. Oral sucker subterminal to ventroterminal, 0.60 to 0.74 millimeter across, partially retracted in such a way that the anterior body wall is raised around it like a collar. Acetabulum 0.86 to 1.00 millimeter in diameter, very proximate to oral sucker. Pharynx absent; œsophagus very short, practically absent. Intestinal cæca with external and internal lateral branches that are especially prominent in postacetabular region; they reach to near posterior end of body.

Testes tandem, pyramidal with their bases facing each other, with smooth surfaces; they measure 0.18 to 0.30 by 0.48 to

0.56 millimeter; they occupy middle thirds of postacetabular body length, the distance from posterior border of acetabulum to anterior testis and that from second testis to posterior end of body being about the same. What appears to be a small cirrus sac is found on the right of first testis.

Ovary roundish, intertesticular, on right side of median line, 0.16 millimeter across. Shell gland median, larger than and beside ovary. Uterine sac a median longitudinal canal extending from immediately behind acetabulum to first testis. Vitellaria not evident.

Excretory pore dorsal, near posterior end of body.

Specific diagnosis.—Clinostomum: Body elongate oval, 4.20 to 4.45 by 1.85 to 2.20 millimeters in size. Suckers very proximate, the oral smaller than the ventral. Cæca with prominent external and internal lateral branches. Ovary roundish, 0.16 millimeter across. Uterine sac median, longitudinal, from immediately behind acetabulum to first testes.

Host.—Ophiocephalus striatus.

Location.—Encysted in eye-sockets and pericardium.

Locality.—Los Baños, Laguna, Luzon.

Type specimens.—Philippine Bureau of Science parasitological collection No. 277.

CLINOSTOMUM PSEUDOHETEROSTOMUM sp. nov. Plate 3, fig. 1.

Two individuals of this parasite were presented by Dr. D. Villadolid, of the College of Agriculture, University of the Philippines, Los Baños, who found them encysted between the femoral muscles of a frog. The fluke is characterized by the form of its testes, the anterior testis being U-shaped and the posterior V-shaped. In this respect it is similar to the adult *Clinostomum heterostomum* (Rudolphi), as described by Braun (1900). A detailed comparison between the two forms, however, cannot be made, for a description of the corresponding immature stage of the latter is not available.

Description.—Body elongate, slightly tapering towards both ends, 6.6 to 7.2 by 1.8 to 2.0 millimeters in size. Cuticle apparently unarmed. Oral sucker subterminal, 0.60 to 0.64 by 0.70 to 0.80 millimeter in size; it is not retracted, hence neither collar nor oral field is visible. Acetabulum 0.98 to 1.08 by 1.10 to 1.24 millimeters in size, between anterior and middle thirds of body length. Pharynx absent; œsophagus very short, practically absent. Intestinal cæca long, with short lateral branches, extend to near posterior end of body.

Testes tandem, in anterior half of last third of body length; anterior testis U-shaped, measures 0.52 to 0.60 by 0.70; posterior testis V-shaped, 0.50 by 0.54 to 0.62 millimeter.

Ovary small, intertesticular, on right side of median line, 0.16 by 0.12 millimeter in size. Shell gland median, slightly larger than and lateral to ovary. Uterine sac prominent, cylindrical, median, from about 0.3 millimeter behind acetabulum to immediately in front of anterior testis. Vitellaria not evident.

Excretory pore median, on dorsal surface, near posterior end of body.

Specific diagnosis.—Clinostomum: Body elongate, 6.6 to 7.2 by 1.8 to 2.0 millimeters in size. Oral sucker 0.60 to 0.64 by 0.70 to 0.80; acetabulum 0.98 to 1.08 by 1.10 to 1.24 millimeters in size, between anterior and middle thirds of body length. Testes dissimilar: anterior testis U-shaped, posterior testis V-shaped.

Host.—Rana magna.

Location.—Encysted between femoral muscles.

Locality.—Los Baños, Laguna, Luzon.

Type specimens.—Philippine Bureau of Science parasitological collection No. 22.

HAPLORCHIS ANGUILLARUM sp. nov. Plate 4, fig. 3.

Only a single specimen of this fish trematode is available for description. With the exception of its possessing two testes it tallies with the characterization of the genus *Haplorchis* Looss, 1899. The presence of double testes is here considered of specific rather than of generic importance in the same way that among the amphistomatous flukes the number of these organs is used to separate the members of the genus *Diplodiscus.*

Description.—Body small, elongate, 2.9 millimeters in length by 0.56 millimeter in maximum breadth at level of œsophageal bifurcation. Cuticle armed with numerous small spines from anterior end to level midway between second testis and posterior end of body. Oral sucker ventroterminal, 0.15 by 0.18 millimeter in size. Prepharynx 0.34 millimeter long; pharynx 0.14 by 0.16 millimeter in size; œsophagus 0.18 millimeter long, bifurcates in front of genital pore. Intestinal cæca simple, extend to about 0.20 millimeter from posterior end of body. Acetabulum absent.

Testes two, spherical, tandem, immediately postovarial; anterior testis slightly larger, 0.26 millimeter in diameter; posterior testis 0.24 millimeter across. Cirrus pouch absent. Vesicula

seminalis free in parenchyma, median, preovarial; it is in the form of a bent sac, constricted near anterior end and measures 0.42 by 0.13 millimeter. A short prostate surrounded by a few prostate glands arises from anterior end of the vesicula seminalis and is followed by an equally short ejaculatory duct. Genital pore median, behind œsophageal bifurcation; it is surrounded by a small genital sucker 0.10 by 0.13 millimeter in size and guarded by five pointed chitinous spines.

Ovary median, slightly compressed, immediately preëquatorial, 0.14 by 0.17 millimeter in size. Oviduct arises from posterior border of ovary. Receptaculum seminis well developed, to right side of median line, between ovary and anterior testis. Laurer's canal not discernible. Vitellaria moderate, somewhat in lattice work, mostly behind second testis but not reaching level of blind ends of intestinal cæca. Vitelline ducts pass anteriorly ventral to testes and meet in median line to form a small roundish vitelline reservoir. Latter and poorly developed shell gland occur alongside receptaculum seminis. Uterus moderately long, mostly posttesticular, arranged in short descending and ascending coils and extend posteriorly beyond terminations of intestinal cæca. No eggs present; instead uterus is filled with brownish granular material.

Excretory pore posteroterminal.

Specific diagnosis.—Haplorchis: Body elongate, 2.9 by 0.56 millimeters in size. Cuticle armed with small spines from anterior end to behind second testis. Testes two, spherical, tandem; anterior testis 0.26, second testis 0.24 millimeter in diameter. Genital pore guarded by five pointed chitinous spines.

Host.—Anguilla mauritiana (Bennet).

Location.—Intestine.

Locality.—Palo, Leyte.

Type specimen.—Philippine Bureau of Science parasitological collection No. 392.

SCAPHANOCEPHALUS ADAMSI sp. nov. Plate 5, fig. 2.

Two members of the genus *Scaphanocephalus* Jaegerskioeld, 1903, have been described; namely, *S. expansus* (Creplin, 1842) and *S. australis* Johnston, 1916. Both of them were obtained in the adult stage from sea eagles in Europe and Australia, respectively. The present form, which is immature, was found encysted in the fins and under the scales of several individuals of *Lepidaplois mesothorax*, a marine fish, that died in the aquarium of the Fish and Game Administration. Specimens were

found by members of the Philippine Fish and Game Administration. It is most reasonable to expect from what is known of the development of heterophyid flukes in general that the worm under consideration represents the metacercarial stage of a parasite infesting a fish-eating bird, probably a hawk or an eagle.

Except for the absence of the vitelline glands and eggs in the uterus, the worm has reached such a stage of development that it can very well be compared for purposes of differentiation with its adult relatives. Unfortunately, however, the description of *Scaphanocephalus expansus* is not available to me, hence it will only be compared with *S. australis*. It may be distinguished from the latter by its shorter œsophagus, its branched testes, and lobulated or almost follicular ovary. I have the pleasure of naming this trematode for Mr. Wallace Adams, chief of the Fish and Game Administration, who has shown active interest in the study of parasites infesting fishes in the Philippines.

Description.—The cysts are practically circular discs measuring about 3 millimeters in diameter. Unlike other cysts they are hard, opaque and very resistant to pressure, the walls having the consistency of cartilage. For this reason they are difficult to dissect and from one dozen cysts that were opened only two perfect worms were obtained.

Body characteristically T-shaped due to expanded anterior portion, which is membranous; measures in millimeters 3.02 to 3.07 in length by 2.15 to 2.37 in maximum breadth in anterior region and 1.17 to 1.21 across level of first testis in posterior region. Anterior surface up to level midway between genital pore and ovary armed with very minute spines that are buried in the cuticle. Oral sucker measures 0.12 by 0.11 to 0.13 millimeter, withdrawn from anterior end, followed by pharynx 0.08 to 0.09 by 0.08 millimeter in size. Œsophagus 0.06 to 0.11 millimeter long, divides into two simple narrow cæca that take an irregular zigzag course towards the posterior end. Acetabulum reduced, not distinct from the so-called genital sucker; the combined structures or the ventrogenital sac of Witenberg (1929) measure 0.18 to 0.21 by 0.13 to 0.19 millimeter and occupy a median position in anterior third of body length, about midway between oral sucker and ovary. Genital pore in posterior half of ventrogenital sac.

Testes tandem, postovarial, branched; anterior testis 0.19 to 0.23 by 0.74 to 0.76, posterior testis 0.20 to 0.27 by 0.72 to 0.80

millimeter in size. Vasa efferentia meet at some distance in front of ovary forming a common duct, the vas deferens, which is not much larger in diameter than any of the vasa efferentia. Cirrus sac absent. Shortly before entering the ventrogenital sac, the vas deferens is surrounded for a short distance of its length by unicellular prostatic cells.

Ovary multilobed or follicular, median, immediately postequatorial, measures 0.10 to 0.11 by 0.27 to 0.28 millimeter. Receptaculum seminis and Laurer's canal behind ovary. Shell gland small, at almost the same level as seminal receptacle but on left side of median line. Uterus in loose coils between ventrogenital sac and ovary. Eggs and vitelline glands not yet developed.

Visible portions of excretory and nervous systems very similar in arrangement to those of *Scaphanocephalus australis.*

Specific diagnosis.—Scaphanocephalus: Length 3.02 to 3.07 millimeters, maximum breadth 2.15 to 2.37 across anterior region and 1.17 to 1.21 across first testis in posterior region. Cuticle armed with very minute spines from anterior end to level midway between genital pore and ovary. Œsophagus 0.06 to 0.11 millimeter long. Ovary multilobed or follicular, immediately postequatorial. Testes branched.

Host.—Lepidaplois mesothorax.

Location.—Encysted in fins and under scales.

Locality.—Manila, P. I.

Type specimens.—Philippine Bureau of Science parasitological collection No. 426.

AUSTROBILHARZIA BAYENSIS sp. nov. Plate 1, fig. 3.

This is represented by a single male specimen collected from the migratory snipe, *Gallinago gallinago.* It differs from *Austrobilharzia terrigalensis* Johnston, 1916, in the number of its testes, which is twenty-six, the Australian form possessing only eighteen to twenty.

Description.—Body of male elongate, 5.2 millimeters in length by 0.32 millimeter in maximum width across middle. Cuticle smooth. Oral sucker 0.18 by 0.14 millimeter in size, anteroterminal. Acetabulum 0.22 millimeter in anteroposterior diameter, between first and second seventh of body length. Œsophagus 0.7 millimeter long, bifurcates immediately behind acetabular level. Cæca take a wavy posterior course, uniting at about 1.5 millimeters from posterior end of body; the resulting trunk reaches near posterior extremity. Gynæcophoric canal well

developed, extends from immediately behind acetabulum to posterior end of body.

Testes twenty-six in number, spherical or slightly compressed, 66.5 to 87.3 microns across, arranged in longitudinal series from a short distance behind genital pore to middle of body length; the testicular expanse is about 1.5 millimeters. Cirrus pouch flask-shaped, 0.16 by 0.10 millimeter in size; incloses seminal vesicle and prostate. Genital pore on ventral surface, about equidistant between acetabulum and first testis.

Specific diagnosis.—Austrobilharzia: Female unknown. Male 5.2 by 0.32 millimeters in size. Testes twenty-six in number, spherical or slightly compressed, 66.5 to 87.3 microns across.

Host.—Gallinago gallinago.

Location.—Mesenteric vessel.

Locality.—Bay, Laguna, Luzon.

Type specimen.—Philippine Bureau of Science parasitological collection No. 315.

NEODIPLOSTOMUM ALUCONIS sp. nov. Plate 6, fig. 1.

This parasite is represented by several specimens collected from the small intestine of an owl. It bears a superficial resemblance to *Neodiplostomum longum* Brandes, 1890. It differs from it in the extent of its vitellaria which do not reach anteriorly the level of the acetabulum while posteriorly they extend to near the posterior end of the body; in the presence of minute cuticular spines; and in the shape of the testes, the extremities of which are bent ventrally.

Description.—Body with a total length of 3.15 to 5.40 millimeters, divided distinctly into two regions. Cuticle armed with very minute spines from anterior end to at least level of ovary. Forebody flattened, its lateral margins inrolled ventrally and uniting posteriorly behind adhesive disc and in front of junction of fore- and hindbody; it measures 1.25 to 1.62 by 0.54 to 0.92 millimeters. Lateral suctorial cups or earlike appendages absent. Hindbody cylindrical, generally more than twice as long as forebody, measures 1.90 to 3.78 millimeters in length by 0.38 to 0.65 millimeter in maximum diameter across any of the testes. Oral sucker anterosubterminal, 0.054 to 0.075 by 0.058 to 0.066 millimeter in size; pharynx 0.062 to 0.075 by 0.037 to 0.054; œsophagus 0.041 to 0.066 millimeter long; intestinal cæca simple, extend to near posterior end of body. Acetabulum 0.070 to 0.083 by 0.083 to 0.090 millimeter, in middle of length of forebody or immediately in front of that level.

Adhesive disc elongate oval, 0.36 to 0.70 by 0.22 to 0.36 millimeter in size, immediately postacetabular, with a shallow elongate cavity. Adhesive gland not prominent, U-shaped, dorsal to posterior end of adhesive disc.

Testes tandem, postovarial, transversely elongate, sometimes slightly constricted at middle, their extremities bent ventrally; they measure 0.14 to 0.34 by 0.24 to 0.60 millimeter. Vesicula seminalis poorly developed, posttesticular. Genital pore median, dorsal, near posterior end of body.

Ovary transversely ovoid, immediately behind equator of hindbody, 0.10 to 0.16 by 0.12 to 0.34 millimeter in size. Oötype complex intertesticular. Vitellaria profuse, in both body regions, extending from anterior level of adhesive disc to near posterior end of body; they penetrate into adhesive disc. Uterus well developed, confined in hindbody. Eggs oval, yellowish, thin-shelled, operculated, 91.5 to 95.6 by 52 to 58.2 microns in size.

Specific diagnosis.—Neodiplostomum: Total length 3.15 to 5.40 millimeters; forebody 1.25 to 1.62 by 0.54 to 0.92, hindbody 1.90 to 3.78 by 0.38 to 0.65. Cuticle armed with minute spines at least up to level of ovary. Testes transversely elongate, 0.14 to 0.34 by 0.24 to 0.60 millimeter, their extremities bent ventrally; ovary 0.10 to 0.16 by 0.12 to 0.34. Vitellaria extend from anterior level of adhesive disc to near posterior end of body. Eggs 91.5 to 95.6 by 52 to 58.2 microns.

Host.—Aluco longimembris.

Location.—Small intestine.

Locality.—Obando, Bulacan, Luzon.

Type specimens.—Philippine Bureau of Science parasitological collection No. 150.

APHARYNGOSTRIGEA GARCIAI sp. nov. Plate 6, fig. 2.

This species is named for Mr. Simplicio Garcia, who collected numerous specimens of the parasite from the intestine of an egret. It is readily distinguished from the other members of the genus *Apharyngostrigea* Ciurea, 1927, as described by Szidat (1929), by its multilobulated testes.

Description.—Body 2.8 to 5 millimeters in total length, characteristically strigeid in shape and distinctly divided into two regions. Forebody approximately cubic, with rounded angles, 1 to 1.5 by 1.15 to 1.40 by 1.20 to 1.35 millimeters. Hindbody vase-shaped, constricted off from forebody, expanded in middle, 1.8 to 3.5 by 1.2 to 1.4 by 1 to 1.45 millimeters in dimensions. Oral sucker weak, 0.20 to 0.26 millimeter across, visible through

opening of cavity of forebody. Acetabulum also weak, near middle of length of forebody, 0.22 to 0.30 millimeter across. Pharynx absent. Holdfast apparatus well developed, filling up most of cavity of forebody; its component lamellæ have not been ascertained. Adhesive gland median, transversely oval, at junction of two body regions, measuring 0.16 to 0.22 by 0.30 to 0.36 by 0.26 to 0.30 millimeter.

Testes tandem, immediately postovarial, multilobulated, measuring 0.60 to 0.70 by 0.90 to 1.1 by 0.85 to 0.96 millimeters; they partly overlap so that it is sometimes difficult to distinguish them individually. Vesicula seminalis well developed, coiled, median, immediately behind second testis. Genital pore on tip of a genital cone and opens into a genital sinus at posterior end of body.

Ovary median transversely compressed, with smooth surface, in anterior third of hindbody length, 0.22 to 0.40 by 0.48 to 0.68 by 0.45 to 0.50 millimeter in dimensions. Oötype complex intertesticular, as is usual among holostomes; Laurer's canal opens dorsally opposite first testis. Vitellaria well developed, especially in forebody, where the vitelline follicles are profusely distributed; in hindbody they also occupy most of the space not otherwise occupied by the other reproductive structures, reaching to near posterior end of body. Uterus moderately long, confined in hindbody, passing ventral to genital glands. Eggs oval, yellowish, thin-shelled, operculated, 87.5 to 95.6 by 60 to 62.5 microns in size.

Excretory pore slitlike, dorsal, at a level about equidistant between vesicula seminalis and posterior end of body.

Specific diagnosis.—Apharyngostrigea: Total length 2.8 to 5 millimeters; forebody measures 1 to 1.5 by 1.15 to 1.4 by 1.2 to 1.35, hindbody 1.8 to 3.5 by 1.2 to 1.4 by 1 to 1.45 millimeters. Testes multilobulated. Eggs 87.5 to 95.6 by 60 to 62.5 microns in size.

Host.—Herodias timoriensis.

Location.—Small intestine.

Locality.—Iriga, Camarines Sur, Luzon.

Type specimens.—Philippine Bureau of Science parasitological collection No. 355.

TETRACOTYLE BICOLANDIÆ sp. nov. Plate 5, fig. 1.

Various kinds of tetracotyles have been found encysted in mollusks, leeches, and animals of the different classes of vertebrates. These are larval forms, representing the young stages

(metacercariæ) of certain strigeid flukes. One species, *Tetracotyle orientalis*, according to Faust (1921), is the larva of *Cyathocotyle orientalis;* while another, *T. communis* Hughes, 1928, according to La Rue (1932), is the young stage of *Cotylurus communis.*

The present form was found encysted in the subcutaneous tissue of the neck of a tern (*Sterna sinensis*). The bird was received in the laboratory already skinned and preserved in formalin solution. The description that follows, therefore, is based entirely on preserved specimens.

Description.—Cyst whitish, opaque, globular to ovoid, 0.60 to 0.75 by 0.40 to 0.70 millimeter in size. Cyst wall composed of two layers; namely, an outer layer, probably of host origin, composed of connective tissue and averaging 0.08 to 0.16 millimeter in thickness; and an inner hyaline layer, probably of parasite origin, 0.008 to 0.02 millimeter thick. Cavity of cyst 0.34 to 0.42 by 0.20 to 0.26 millimeter in size, the greater part occupied by parasite.

Body of worm ovoid, broader anteriorly, 0.28 to 0.36 millimeter in length by 0.20 to 0.25 millimeter in maximum breadth; division of body into anterior and posterior regions as seen in adult holostomes not apparent. Anteriorly there is a small, terminal or subterminal circular opening that apparently leads posteriorly into a potential cavity occupied by adhesive apparatus. Cuticle smooth.

Oral sucker ventral, near anterior end, 0.050 to 0.062 millimeter across. Acetabulum equatorial in position, larger than oral sucker, 0.066 to 0.083 by 0.075 to 0.083 millimeter in size. Pharynx measures 0.025 by 0.033 millimeter, œsophagus very short, divides immediately into two cæcal branches, the posterior extent of which beyond the adhesive organ is not visible.

On each side of pharynx on ventral surface, is an inpocketing of the cuticula, forming a so-called lateral sucker, which is smaller than or almost as large as the oral sucker and has a prominent opening. Adhesive organ large, transversely oval, immediately behind acetabulum, 0.040 to 0.060 by 0.104 to 0.120 millimeter in size; its simple cavity communicates with the exterior through a W-shaped opening. Adhesive gland transversely elongate, prominent in stained specimens, immediately behind adhesive organ, measures 0.023 to 0.037 by 0.070 to 0.100 millimeter.

Rudiment of reproductive system in the form of a globular mass of deeply staining cells, 0.025 to 0.030 millimeter in diameter and located immediately behind adhesive gland.

Main excretory or urinary bladder at posterior portion of body, somewhat V-shaped, opens to exterior through posteroterminal excretory pore. Spaces are visible through cuticle near lateral margins of body that are filled with solid calcareous granules; these probably represent the so-called reserve bladders, described by Hughes (1928, 1929) and others in related parasites.

Specific diagnosis.—Tetracotyle: Cyst globular to ovoid, 0.60 to 0.75 by 0.40 to 0.70 millimeter in size. Body of worm ovoid, broader anteriorly, measures 0.28 to 0.36 by 0.20 to 0.25 millimeter. Cuticle smooth. Oral sucker 0.050 to 0.062 millimeter across; acetabulum equatorial, 0.066 to 0.083 by 0.075 to 0.083 millimeter; pharynx 0.025 by 0.033 millimeter; œsophagus short. Adhesive organ transversely oval, 0.040 to 0.060 by 0.104 to 0.120 millimeter. Adhesive gland transversely elongate, 0.023 to 0.037 by 0.070 to 0.100 millimeter. Genital anlage globular, 0.025 to 0.030 millimeter across.

Host.—Sterna sinensis.

Location.—Encysted in subcutaneous tissue of neck..

Locality.—Iriga, Camarines Sur, Luzon.

Type specimens.—Philippine Bureau of Science parasitological collection No. 318.

SYSTEMATIC LIST OF TREMATODE PARASITES SO FAR REPORTED FROM PHILIPPINE VERTEBRATES

The known species of flukes infesting vertebrates, including man, in the Philippines now total sixty-nine. For the purpose of ready reference these are systematically arranged below together with their hosts.

Class TREMATODA Rudolphi, 1808

Subclass MONOGENEA van Beneden, 1858

Order MONOPISTHODISCEA (Fuhrmann, 1928)

Family GYRODACTYLIDÆ van Beneden and Hesse, 1863

ANCYROCEPHALUS MANILENSIS Tubangui, 1931.

Hosts.—Teuthis virgata, Lutianus lioglossus, Anyperodon leucogrammicus (gills).

TETRANCISTRUM LUTIANI Tubangui, 1931.

Host.—Lutianus lioglossus (gills).

Order POLYOPISTHOCOTYLEA Odhner, 1912

Family MICROCOTYLIDÆ Taschenberg, 1879

MICROCOTYLE VIRGATARUM Tubangui, 1931.

Host.—Teuthis virgata (gills).

Subclass DIGENEA van Beneden, 1858

Order PROSOSTOMATA Odhner, 1908

Suborder MONOSTOMATA Zeder, 1800

Family CYCLOCŒLIDÆ Kossack, 1911

CYCLOCOELUM (POSTPHARYNGEUM) OBSCURUM (Leidy, 1887).

Host.—Totanus eurhinus (cervical air sac).

This was originally described under the name *Cyclocoelium* (*Postpharyngeum*) *orientale* var. *eurhinus* due to its close resemblance to *C. orientale* Skrjabin, 1913 (see Tubangui, 1932). Due to oversight I failed to note that Witenberg (1928) considers Skrjabin's species as well as *C. halcyonis* MacCallum, *C. leidyi* Harrah, *C. obliquum* Harrah and *C. vicarium* (Arnsdorf) as synonyms of *C. obscurum*. If the morphology of the latter is as variable as Witenberg purports to show, there is no justification in retaining the Philippine species as an independent variety.

Family NOTOCOTYLIDÆ Luehe, 1909

NOTOCOTYLUS INTESTINALIS Tubangui, 1932.

Host.—Domestic duck (intestine).

NOTOCOTYLUS NAVIFORMIS Tubangui, 1932.

Host.—Domestic duck (intestine).

Suborder STRIGEATA La Rue, 1926

Superfamily STRIGEOIDEA Railliet, 1919

Family STRIGEIDÆ (Railliet, 1919)

STRIGEA MCGREGORI Tubangui, 1932.

Host.—Butastur indicus (intestine).

PARASTRIGEA INTERMEDIA Tubangui, 1932.

Host.—Butastur indicus (intestine).

APHARYNGOSTRIGEA GARCIAI sp. nov.

Host.—Herodias timoriensis (small intestine).

COTYLURUS MAMILLIFORMIS Tubangui, 1932.

Host.—Snipe (? *Gallinago gallinago*) (intestine).

TETRACOTYLE BICOLANDIAE sp. nov.

Host.—Sterna sinensis (encysted in subcutaneous tissue of neck).

Family ALARIIDÆ (Tubangui, 1922) Bosma, 1931

Subfamily NEODIPLOSTOMINÆ Dubois, 1932

PROALARIA BUTASTURINA Tubangui, 1932.

Host.—Butastur indicus (small intestine).

Dubois (1932) considers the genus *Proalaria* La Rue, 1926, as a synonym of *Diplostomum* von Nordmann, 1832. In that case this parasite will be known as *Diplostomum butasturinum.*

NEODIPLOSTOMUM ALUCONIS sp. nov.

Host.—Aluco longimembris (small intestine).

Superfamily SCHISTOSOMATOIDEA Stiles and Hassall, 1926

Family SCHISTOSOMATIDÆ Looss, 1899

Subfamily SCHISTOSOMATINÆ Stiles and Hassall, 1898

SCHISTOSOMA JAPONICUM Katsurada, 1904.

Host.—Man (portal blood system).

AUSTROBILHARZIA BAYENSIS sp. nov.

Host.—Gallinago gallinago (mesenteric vessel).

Suborder AMPHISTOMATA (Rudolphi, 1801)

Family PARAMPHISTOMATIDÆ Fischoeder, 1901

Subfamily PARAMPHISTOMATINÆ Fischoeder, 1901

PARAMPHISTOMUM EXPLANATUM (Creplin, 1847).

Hosts.—Cattle and carabao (rumen).

This was reported by Schwartz (1925). In the same year, without having seen Schwartz's paper, I reported what is apparently the same parasite as *Paramphistomum cervi* (Zeder, 1790). A reëxamination of my material has convinced me that Doctor Schwartz's determination is correct.

I make no distinction in this paper among the various domesticated breeds of cattle and carabaos that exist in the Philippines; such as, *Bos taurus, Bos indicus, Bos kerabau,* and *Bubalus bubalus.* According to my observations native and Indian buffaloes are susceptible to the same kinds of helminths and the same thing is true with respect to native and Indian cattle.

PARAMPHISTOMUM ANISOCOTYLEA Faust, 1920.

Hosts.—Cattle and carabao (? rumen).

COTYLOPHORON COLYLOPHORUM (Fischoeder, 1901).

Hosts.—Cattle and carabao (rumen).

Subfamily GASTROTHYLACINÆ Stiles and Goldberger, 1910

GASTROTHYLAX CRUMENIFER (Creplin, 1847).

Hosts.—Cattle and carabao (rumen).

CARMYERIUS GREGARIUS (Looss, 1896).

Hosts.—Cattle and carabao (rumen and reticulum).

FISCHOEDERIUS ELONGATUS (Poirier, 1883).

Hosts.—Cattle and carabao (rumen).

Subfamily GASTRODISCINÆ Monticelli, 1892

HOMALOGASTER PALONIAE Poirier, 1883.

Host.—Cattle (cæcum).

Subfamily DIPLODISCINÆ Cohn, 1904

DIPLODISCUS AMPHICHRUS sp. nov.

Hosts.—Frogs (small intestine and rectum).

Suborder DISTOMATA Zeder, 1800

Family FASCIOLIDÆ Railliet, 1895

Subfamily FASCIOLINÆ Stiles and Hassall, 1898

FASCIOLA HEPATICA (Linnæus, 1758).

Hosts.—Cattle, carabao, sheep, goat (bile ducts).

FASCIOLA GIGANTICA COBBOLD, 1856.

Hosts.—Cattle, carabao, sheep, goat (bile ducts).

Subfamily FASCIOLOPSINÆ Odhner, 1910

FASCIOLOPSIS BUSKI (Lankester, 1857).

Host.—Man (small intestine).

Reported by Schwartz (1924), who found the eggs of the parasite in the stools of several Chinese in the town of Jolo, Sulu Archipelago, P. I. It is not definitely known whether the infestation was contracted locally or in China.

Family ECHINOSTOMATIDÆ Looss, 1902

Subfamily ECHINOSTOMATINÆ Looss, 1899

ECHINOSTOMA REVOLUTUM (Froelich, 1802).

Host.—Domestic duck (cæcum) and domestic pigeon (small intestine).

ECHINOSTOMA CHLOROPODIS var. PHILIPPINENSIS Tubangui, 1932.

Host.—*Gallinula chloropus* (small intestine).

ECHINOSTOMA BATANGUENSIS Tubangui, 1932.

Host.—*Gallinula chloropus* (small intestine).

NEPHROSTOMUM BICOLANUM sp. nov.

Hosts.—*Herodias timoriensis* and *Bubulcus coromandus* (small intestine).

ECHINOPARYPHIUM RECURVATUM (v. Linstow, 1873).

Host.—Domestic duck (small intestine).

EUPARYPHIUM ILOCANUM (Garrison, 1909).

Hosts.—Man and *Mus norvegicus* (small intestine).

EUPARYPHIUM GUERREROI Tubangui, 1931.

Host.—*Mus norvegicus* (small intestine).

EUPARYPHIUM MURINUM Tubangui, 1931.
Host.—Mus norvegicus (small intestine).

Subfamily HIMASTHLINÆ Odhner, 1911

ACANTHOPARYPHIUM OCHTHODROMI sp. nov.
Host.—Ochthodromus mongolus (small intestine).

Subfamily ECHINOCHASMINÆ Odhner, 1911

ECHINOCHASMUS NOVALICHESENSIS Tubangui, 1932.
Host.—Hypotænidia torquata (small intestine).

Family PSILOSTOMIDÆ Odhner, 1913

PSILOCHASMUS LONGICIRRATUS Skrjabin, 1913.
Host.—Domestic duck (intestine).

Family AZYGIIDÆ Odhner, 1911

AZYGIA PRISTIPOMAI Tubangui, 1928.
Host.—Pristipoma hasta (intestine).

Family OPISTHORCHIIDÆ Luehe, 1901

Subfamily OPISTHORCHIINÆ Looss, 1899

OPISTHORCHIS WARDI Wharton, 1921.
Host.—Domestic cat (bile ducts).

Subfamily METORCHIINÆ Luehe, 1909

METORCHIS CAINTAENSIS Tubangui, 1928.
Host.—Hypotænidia philippensis (intestine).

Family TELORCHIIDÆ Stunkard, 1924

Subfamily TELORCHIINÆ Looss, 1899

CERCORCHIS CYCLEMIDIS sp. nov.
Host.—Cyclemis amboinensis (intestine).

Family CLINOSTOMIDÆ Luehe, 1901

CLINOSTOMUM DALAGI sp. nov.
Host.—Ophiocephalus striatus (encysted in eye sockets and pericardium).

CLINOSTOMUM PSEUDOHETEROSTOMUM sp. nov.
Host.—Rana magna (encysted between femoral muscles).

Family HARMOSTOMIDÆ Odhner, 1912

Subfamily HARMOSTOMINÆ Braun, 1900

HARMOSTOMUM sp. Tubangui, 1928.
Host.—Dasylophus superciliosus (rectum).

GLAPHYROSTOMUM RALLINARUM Tubangui, 1932.
Host.—Rallina eurizonoides (intestine).

LEUCOCHLORIDIUM DASYLOPHI Tubangui, 1928.
Host.—Dasylophus superciliosus (rectum).

LEUCOCHLORIDIUM HYPOTAENIDIARUM Tubangui, 1932.

Hosts.—*Hypotaenidia striata* and *Turnix fasciata* (intestine).

Family DICROCŒLIIDÆ Odhner, 1911

Subfamily DICROCŒLIINÆ Odhner, 1911

EURYTREMA OVIS Tubangui, 1925.

Hosts.—Sheep (fat surrounding rectum and pancreatic duct) and cattle (pancreatic duct).

PLATYNOSOMUM PHILIPPINORUM Tubangui, 1928.

Host.—*Scutophilus temminckii* (small intestine).

MESOCŒLIUM MEGGITTI Bhalerao, 1927.

Host.—*Mabuya multifasciata* (intestine).

PARADISTOMUM GREGARINUM Tubangui, 1929.

Synonym: *Paradistomum magnum* Tubangui, 1928.

Host.—*Hemidactylus frenatus* (gall bladder).

PARADISTOMUM PALOENSIS sp. nov.

Host.—*Hydrosaurus pustulosus* (gall bladder).

EUPARADISTOMUM VARANI Tubangui, 1931.

Host.—*Varanus salvator* (gall bladder).

Family BRACHYCŒLIIDÆ Johnston, 1912

Subfamily BRACHYCŒLIINÆ Looss, 1899

GLYPTHELMINS STAFFORDI Tubangui, 1928.

Host.—*Rana vittigera* (intestine).

Family LECITHODENDRIIDÆ Odhner, 1910

Subfamily LECITHODENDRIINÆ Looss, 1902

LECITHODENDRIUM OVIMAGNOSUM Bhalerao, 1926.

Host.—*Scutophilus temminckii* (intestine).

LECITHODENDRIUM LUZONICUM Tubangui, 1928.

Host.—*Scutophilus temminckii* (small intestine).

Subfamily PLEUROGENETINÆ Looss, 1899

PLEUROGENOIDES TAYLORI (Tubangui, 1928) Travassos, 1930.

Synonym: *Pleurogenes taylori* Tubangui, 1928.

Host.—*Rana vittigera* (intestine).

POSTORCHIGENES OVATUS Tubangui, 1928.

Host.—*Hemidactylus frenatus* (intestine).

Family STOMYLOTREMATIDÆ Poche, 1925

STOMYLOTREMA ROTUNDA Tubangui, 1928.

Host.—*Hypotaenidia philippensis* (intestine).

Family ALLOCREADIIDÆ (Stossich, 1904) Winfield, 1929

Subfamily ALLOCREADIINÆ Looss, 1902

ORIENTOCREADIUM BATRACHOIDES Tubangui, 1931.

Host.—Clarias batrachus (intestine).

Family PLAGIORCHIDÆ Luehe, 1901

STYPHLODORA RENALIS sp. nov.

Host.—Python reticulatus (kidney).

Family OPECŒLIDÆ (Ozaki, 1925) Ozaki, 1928

OPECOELUS MINIMUS Tubangui, 1928.

Hosts.—Glossobius giurus, G. ocellatus and *Pristipoma hasta* (intestine).

This parasite is an intermediate form between the members of the genus *Opecœlus* Ozaki, 1925, in which the body is elongate and the vitellaria entirely postacetabular, and those of *Opegaster* Ozaki, 1928, in which the body is ovate and the vitellaria extending anteriorly beyond the acetabulum.

Family PHILOPHTHALMIDÆ Travassos, 1921

Subfamily PHILOPHTHALMINÆ Looss, 1899

PHILOPHTHALMUS PROBLEMATICUS Tubangui, 1932.

Host.—Gallus gallus domesticus (conjunctival sac).

PHILOPHTHALMUS RIZALENSIS Tubangui, 1932.

Host.—Domestic duck (conjunctival sac).

Family TROGLOTREMATIDÆ Odhner, 1914

PARAGONIMUS WESTERMANI (Kerbert, 1878).

Host.—Man, cat (lung).

Family HETEROPHYIDÆ Odhner, 1914

Subfamily HETEROPHYINÆ Ciurea, 1924

PHAGICOLA PITHECOPHAGICOLA Faust, 1920.

Host.—Pithecophaga jefferyi (intestine).

Faust (see Faust and Nishigori, 1926) after a restudy of his material renamed the parasite *Ascocotyle pithecophagicola.* Witenberg (1930), however, is of the opinion that it should be retained in the genus *Phagicola* Faust until the morphology of the worm is better known.

Subfamily HAPLORCHINÆ (Looss, 1899) Poche, 1926

HAPLORCHIS ANGUILLARUM sp. nov.

Host.—Anguilla mauritiana (intestine).

Subfamily CERCARIOIDINÆ Witenberg, 1929

SCAPHANOCEPHALUS ADAMSI sp. nov.

Host.—Lepidaplois mesothorax (encysted in fins and under scales).

SYSTEMATIC POSITION UNCERTAIN

METADENA MICROVATA Tubangui, 1928.

Hosts.—Glossobius giurus, G. ocellatus, Pristipoma hasta (intestine).

REFERENCES

BOSMA, N. J.
Alaria mustelae sp. nov., a trematode requiring four hosts. Science n. s. 74 (1931) 521–522.

BRANDES, G.
Die Familie der Holostomiden. Zool. Jahrb. Abt. f. Syst. 5 (1890) 549–604.

BRAUN, M.
Die Arten der Gattung Clinostomum Leidy. Zool. Jahrb. Abt. f. Syst. 14 (1900) 1–48.

CHANDLER, A. C.
Three new trematodes from Amphiuma means. Proc. U. S. Nat. Mus. Art. 3, 63 (1923) 1–7.

COHN, L.
Zur Kenntnis eineger Trematoden. Centralbl. Bakteriol. Parasit. u. Infektionskh. Orig. Abt. 1, 34 (1903) 35–42.

CORT, W. W.
Notes on the trematode genus Clinostomum. Trans. Amer. Micr. Soc. 32 (1913) 169–182.

DIETZ, E.
Die Echinostomiden der Vögel. Zool. Jahrb. Supp. 12 (1910) 265–512.

DUBOIS, G.
Revision des hémistomes et étude de formes nouvelles. Bull. Soc. Neuchatel. Sci. Nat. 56 (1932) 375–412.

FAUST, E. C.
Notes on trematodes from the Philippines. Philip. Journ. Sci. 17 (1920) 627–633.

Phases in the life history of a holostome, Cyathocotyle orientalis nov. spec., with notes on the excretory system of the larva. Journ. Parasit. 8 (1921) 78–85.

FAUST, E. C., and M. NISHIGORI.
The life cycles of two species of Heterophyidae parasitic in mammals and birds. Journ. Parasit. 13 (1926) 91–128.

FUHRMANN, O.
Trematoda, In: Kuekenthal's Handbuch der Zoologie 2 (1923) 1–128.

FUKUI, T.
Studies on Japanese amphistomatous parasites, with revision of the group. Trans. and Abst. Japan. Journ. Zool. 2 (1929) 219–351.

HARDWOOD, P. D.
The helminths parasitic in the Amphibia and Reptilia of Houston, Texas, and vicinity. Proc. U. S. Nat. Mus. Art. 17, 81 (1932) 1–71.

HOLL, F. J.
New trematodes from the newt, Triturus viridescens. Journ. Helminth. 6 (1928) 175–182.

HUGHES, R. C.
Studies on the trematode family Strigeidae (Holostomidae) No. VII. Tetracotyle pipientis Faust. Trans. Am. Micr. Soc. 47 (1928) 42–53.

Studies on the trematode family Strigeidae (Holostomidae) No. XIII. Three species of Tetracotyle. Trans. Am. Micr. Soc. 47 (1928) 414–433.

Studies on the trematode family Strigeidae (Holostomidae) No. XVII. Tetracotyle flabelliformis Faust. Papers Mich. Acad. Science, Arts and Letters 10 (1928) 495–508.

HUNTER, G. W., 3d.
Diplodiscus intermedius sp. nov. from Rana catesbiana Shaw. Journ. Parasit. 17 (1930) 74–79.

JOHNSTON, S. J.
On the trematodes of Australian birds. Journ. and Proc. Roy. Soc. New South Wales 50 (1916) 187–261.

LA RUE, G. R.
Morphology of Cotylurus communis Hughes (Trematoda: Strigeidae). Trans. Amer. Micr. Soc. 51 (1932) 28–46.

LOOSS, A.
Beiträge zur Kenntnis der Trematoden Distomum palliatum nov. spec. und Distomum reticulatum nov. spec. Zeitschr. f. Wissenschafl. Zool. 41 (1885) 390–446.

Weitere Beiträge zur Kenntnis der Trematoden-Fauna Aegyptiens, etc. Zool. Jahr. Abt. f. Syst. 12 (1899) 521–784.

ODHNER, T.
Nordostafrikanische Trematoden, grösstenteils vom Weissen Nile. I. Fascioliden. Results of the Swedish Zoological Expedition to Egypt and the White Nile, 1901, under the Direction of L. A. Jägerskiöld, No. 23A (1910) 1–170.

Die Homologien der weiblichen Genitalwege beiden Trematoden und Cestoden. Zool. Anz. 39 (1912) 337–351.

OSBORN, H. L.
On the structure of Clinostomum marginatum, a trematode parasite of the frog, bass and heron. Journ. Morphol. 23 (1912) 189–228.

OZAKI, Y.
Preliminary notes on a trematode with anus. Journ. Parasit. 12 (1925) 51–53.

On some trematodes with anus. Japan. Journ. Zool. 2 (1928) 5–33.

PERKINS, M.
A review of the Telorchiinae, a group of distomid trematodes. Parasit. 20 (1928) 336–356.

POCHE, F.
Das System der Platodaria. Arch. f. Naturg. Abt. A, 91 (1925) 1–458.

SCHWARTZ, B.

Occurrence of Fasciolopsis buski in the Philippine Islands. In: Proceedings of the Helminthological Society of Washington. Journ. Parasit. 11 (1924) 93.

Internal metazoan parasites collected from ruminants in the Philippine Islands. Philip. Journ. Sci. 26 (1925) 521–533.

STUNKARD, H. W.

Notes on the trematode genus Telorchis, with descriptions of new species. Journ. Parasit. 2 (1915) 57–66.

SZIDAT, L.

Beiträge zur Kenntnis der Gattung Strigea (Abildg.). II. Spezieller Teil: Revision der Gattung Strigea nebst Beschreibung einer Anzahl neuer Gattungen und Arten. Zeitschr. f. Parasitenk. 1 (1929) 688–764.

TRAVASSOS, L.

Pesquizas helminthologicas realisadas en Hamburgo, VI. Genero Pleurogenoides Travassos, 1921. Mem. Inst. Oswaldo Cruz 24 (1930) 63–71.

TUBANGUI, M. A.

Two new intestinal trematodes from the dog in China. Proc. U. S. Nat. Mus. Art. 20, 60 (1922) 1–12.

Metazoan parasites of Philippine domesticated animals. Philip. Journ. Sci. 28 (1925) 11–37.

Trematode parasites of Philippine vertebrates. Philip. Journ. Sci. 36 (1928) 351–371.

Paradistomum gregarinum, a new name for the trematode Paradistomum magnum. Philip. Journ. Sci. 38 (1929) 442.

Trematode parasites of Philippine vertebrates, II: Two echinostome flukes from rats. Philip. Journ. Sci. 44 (1931) 273–283.

Trematode parasites of Philippine vertebrates, III: Flukes from fish and reptiles. Philip. Journ. Sci. 44 (1931) 417–423.

Trematode parasites of Philippine vertebrates, IV: Ectoparasitic flukes from marine fishes. Philip. Journ. Sci. 45 (1931) 109–117.

Worm parasites of the brown rat (Mus norvegicus) in the Philippine Islands, with special reference to those forms that may be transmitted to human beings. Philip. Journ. Sci. 46 (1931) 537–591.

Trematode parasites of Philippine vertebrates, V: Flukes from birds. Philip. Journ. Sci. 47 (1932) 369–404.

The molluscan intermediate host in the Philippines of the Oriental blood fluke Schistosoma japonicum Katsurada. Philip. Journ. Sci. 49 (1932) 295–304.

WITENBERG, G.

Notes on Cyclocoelidae. Ann. & Mag. Nat. Hist. X 2 (1928) 410–417.

Studies on the trematode family Heterophyidae. Ann. Trop. Med. and Parasit. 23 (1929) 131–239.

Corrections to my paper "Studies on the trematode family Heterophyidae." Ann. & Mag. Nat. Hist. X 5 (1930) 412–414.

ILLUSTRATIONS

[Drawn by A. Gonzales and V. V. Marasigan.]

PLATE 1

FIG. 1. *Diplodiscus amphichrus* sp. nov., young adult, ventral view.
2. *Diplodiscus amphichrus* sp. nov., fully mature specimen, ventral view.
3. *Austrobilharzia bayensis* sp. nov., lateral view.

PLATE 2

FIG. 1. *Nephrostomum bicolanum* sp. nov., head collar, ventral view.
2. *Nephrostomum bicolanum* sp. nov., entire worm, ventral view.
3. *Acanthoparyphium ochthodromi* sp. nov., collar, ventral view.
4. *Acanthoparyphium ochthodromi* sp. nov., entire worm, ventral view.

PLATE 3

FIG. 1. *Clinostomum pseudoheterostomum* sp. nov., ventral view.
2. *Cercorchis cyclemidis* sp. nov., ventral view.

PLATE 4

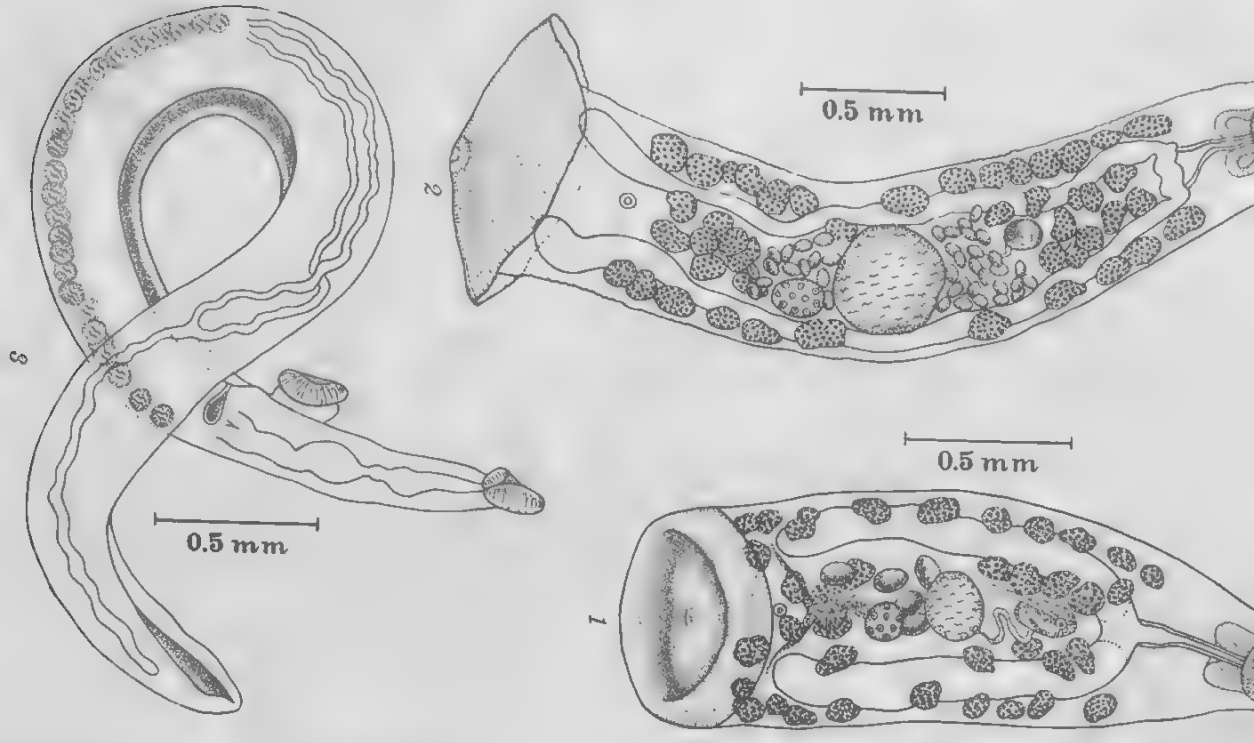
FIG. 1. *Clinostomum dalagi* sp. nov., ventral view.
2. *Paradistomum paloensis* sp. nov., ventral view.
3. *Haplorchis anguillarum* sp. nov., ventral view.
4. *Styphlodora renalis* sp. nov., ventral view.

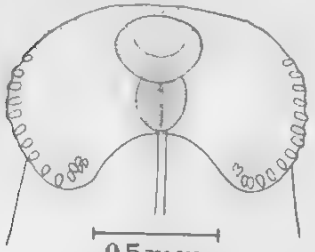
PLATE 5

FIG. 1. *Tetracotyle bicolandiae* sp. nov., ventral view.
2. *Scaphanocephalus adamsi* sp. nov., ventral view.

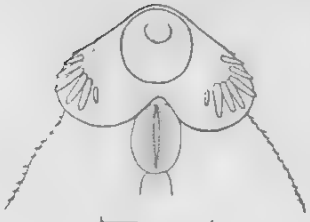
PLATE 6

FIG. 1. *Neodiplostomum aluconis* sp. nov., ventral view.
2. *Apharyngostrigea garciai* sp. nov., ventral view.

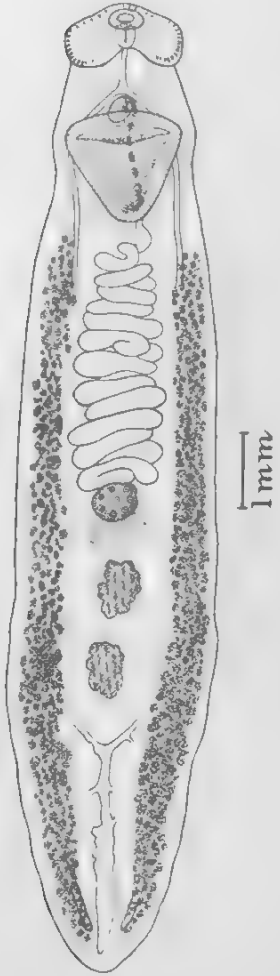

0.5 mm
2
0.5 mm
1
0.5 mm
3



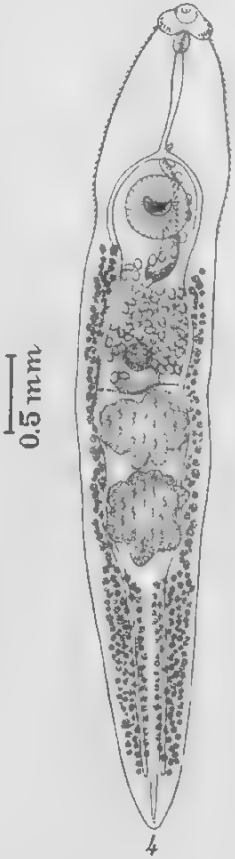
1



3

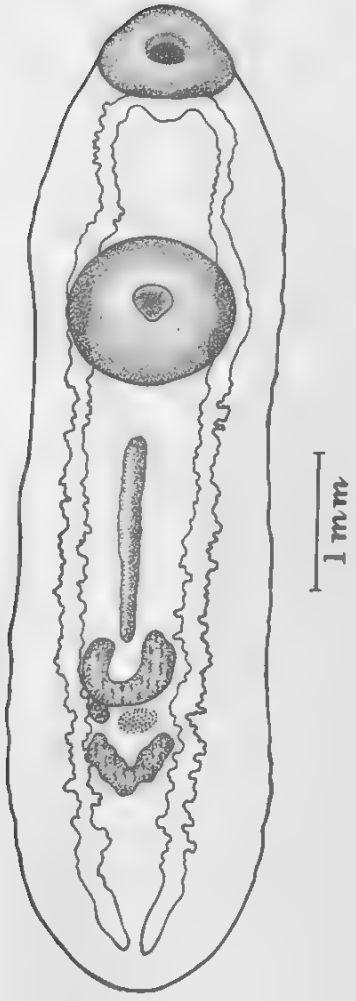


2

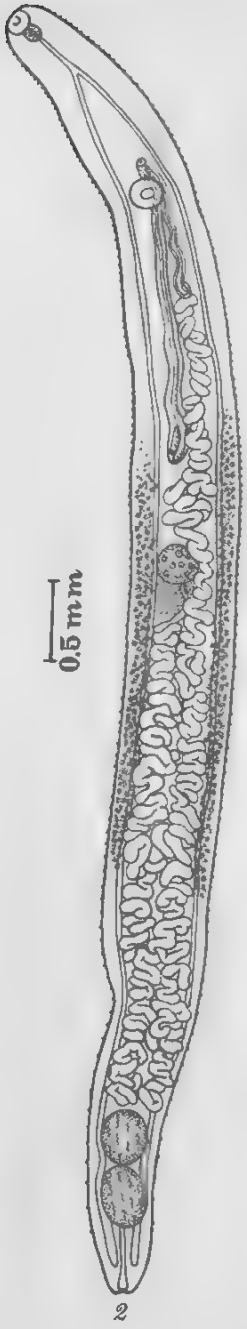


4

PLATE 2.



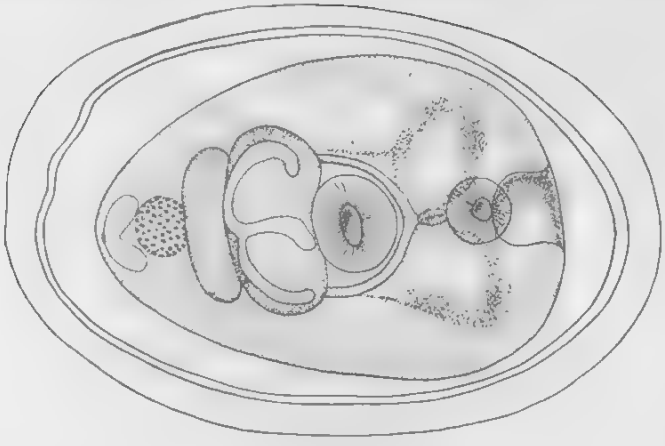
1



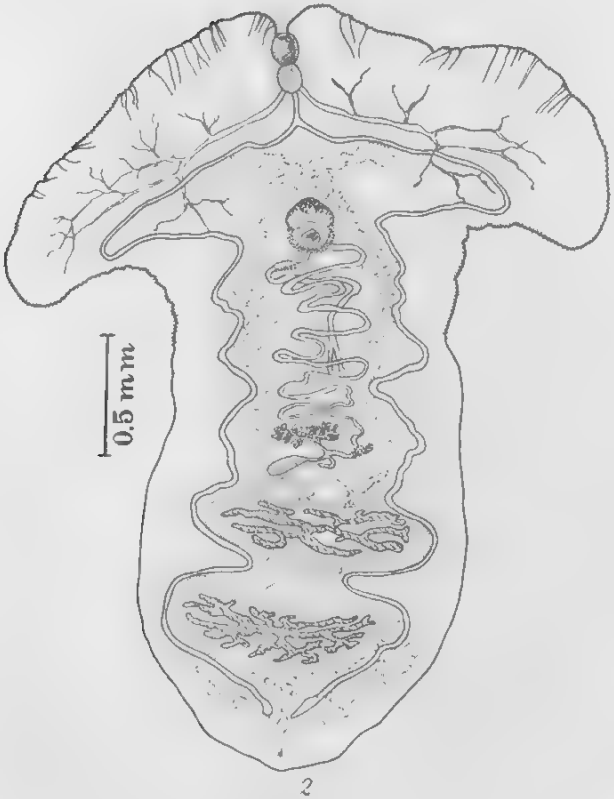
2

PLATE 3.

PLATE 4.



1



2

PLATE 5.

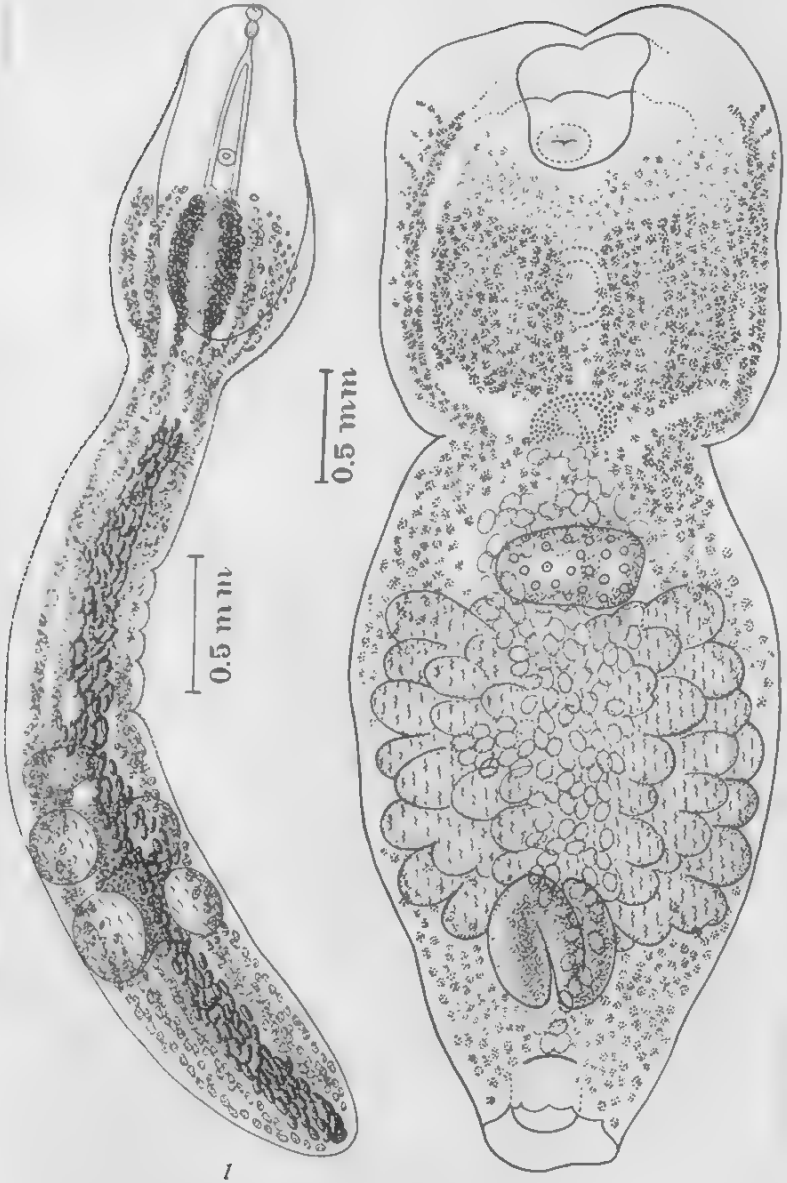


PLATE 6.

NEW SCOLYTIDÆ AND PLATYPODIDÆ FROM THE PHILIPPINE ISLANDS

By KARL E. SCHEDL

Naturhistorisches Museum, Vienna, Austria

A large amount of material, representing the families Scolytidæ and Platypodidæ, has been received from Mr. F. C. Hadden, Agricultural College, Laguna Province, Philippine Islands, and the following are some of the hitherto undescribed species; the remainder will be dealt with as soon as possible. For one species, *Ptilopodius stephegynis* Hopkins, a more-thorough description is given.

XYLEBORUS ARMILLATUS sp. nov.

Description of the female.—Yellowish brown, declivity darker, 2.71 millimeters long, pronotum 1.40 times as long as wide, elytra but little wider than the pronotum and 1.50 times as long as this.

Front subshining, convex, minutely punctulate, on the anterior half sparsely punctured and hairy.

Pronotum cylindrical, base truncate, acutely margined on the sides, posterolateral angles hardly rounded, sides subparallel on more than the basal half, broadly rounded in front; anterior margin unarmed, anterior third of the surface finely asperate, posteriorly rather coarsely but sparsely punctured. Pubescence consisting of long yellow hairs, denser on the sides and the anterior third.

Elytra cylindrical, brightly shining, base truncate, humeral angles feebly rounded, sides subparallel, broadly rounded behind, moderately deeply emarginate at the suture; disc striate-punctate, striæ not impressed, punctures rather remotely placed, interspaces flat, somewhat reticulate, with a few scattered punctures; declivity commencing in the apical third, deeply excavate, lateral margins strongly acute, with a blunt tooth on the summit of the second interspace, another rectangular tooth on the lateral margin in the middle of the declivity, and a third, the smallest, blunt tooth on the posterolateral edge of the excavation, between the teeth are several small setose tubercles;

excavation shining, finely sparsely punctured without indications of striæ. Sparse, long, yellow hairs on the sides, especially laterad on the declivity.

Holotype.—Female, Pangil, Laguna Province, Luzon, April 12, 1931 (*F. C. Hadden*).

This species is closely allied to *Xyleborus cylindromorphus* Eggers, but can easily be separated by the characters of the declivity.

XYLEBORUS LORICATUS sp. nov.

Description of the female.—Uniformly dark yellowish brown, 1.59 millimeters long, 3.27 times as long as wide, pronotum 1.22 times as long as wide, elytra at the base as wide and 1.61 times as long as the pronotum.

Front convex, shining, minutely punctulate, with a few coarse punctures near the epistomal margin.

Pronotum cylindrical, base truncate, posterolateral angles strongly rounded, sides subparallel on more than the basal half, feebly constricted before the middle, broadly rounded in front; anterior margin hardly noticeably crenate, anterior area feebly asperate, with sparse long hairs, posterior area shining, nearly impunctate but minutely reticulate; sides acute but not margined. Scutellum triangular, smooth shining.

Elytra cylindrical, humeral angles rectangular, sides parallel, angulately rounded behind, with a triangular emargination at the suture so that each elytron appears accuminate at the apex; disc shining, rather feebly striate-punctate, striæ not at all impressed, interspaces subrugulose with fine scattered punctures; declivity commencing at the posterior third, convex, acutely margined below, somewhat depressed near the side margins, dull, strial punctures stronger, shining, interspaces densely rugose giving a rough opaque appearance.

Holotype.—One female, Mount Maquiling, Laguna Province, Luzon, November 1, 1933 (*F. C. Hadden*).

A peculiar species, which is distinct from any known form.

XYLEBORUS PERMARGINATUS sp. nov.

Description of the female.—Dark brown, declivity blackish, 5.87 millimeters long, 2.09 times as long as wide, with rather dense, long, erect pubescence.

Front convex, median line slightly elevated and polished, finely roughly punctured above the epistomal margin, transversely elevated between the eyes, elevation centrally nearly devoid of punctures, finely, rugosely punctured along the cephalic

margin of the eyes; transversely impressed above, with deep rather coarse punctures which are densely placed.

Pronotum globose, 1.36 times as wide as long, base truncate, posterolateral angles rectangular, sides parallel on the posterior third, uniformly rounded in front; anterior margin armed with a triangular plate consisting of the fused median teeth, anterior area steep, summit behind the middle, the entire surface asperate, denser and coarser anteriorly, more remotely placed and finer behind. Scutellum small, cordiform, shining.

Elytra as wide and 1.64 times as long as the pronotum, cylindrical, sides subparallel, slightly dilated towards the declivity, broadly rounded behind; disc shining, with a feeble transverse impression before the declivity, densely coarsely punctured, the striæ obsolete near the base, more distinct towards the declivity where they become also feebly impressed; declivity commencing shortly behind the middle, obliquely truncated, with an elevated, well-defined, crenulate margin all around, declivous face slightly covex, suture somewhat depressed, first interstice with a row of punctures, second slightly elevated, widened, densely punctured and with a few small tubercles at the center, other striæ feebly but distinctly impressed, interspaces densely roughly punctured.

Holotype.—Female, Mount Maquiling, Laguna Province, Luzon, August 16, 1931 (*F. C. Hadden*).

Paratypes.—Two females, same data.

This species was kindly compared with other material by Mr. Hans Eggers. It is identical with his *X. permarginatus* in lit., and his name has been adopted.

Xyleborus desectus Eggers, which is closely allied to my species, is smaller, the elytra are slenderer, and the declivital margin is much lower.

PTILOPODIUS STEPHEGYNIS Hopkins.

Description of the adult beetle.—Pronotum dark brown, elytra reddish brown, 1.19 millimeters long, exactly twice as long as wide.

Front plano-convex, minutely and very densely punctured, with a low longitudinal carina extending from the epistomal margin to the vertex, at first inconspicuous, shortly above the epistomal margin interrupted by a small patch of very coarse punctures which are situated on and at the sides of the frontal suture, above broad, distinctly elevated; anterior area with medium long scattered hairs. Eyes oblong, not emarginate in front; antennæ

with the club oval, 1.36 times as long as broad, without septa or sutures, anterior face moderately densely covered with short filiform setæ, posterior face with a few scattered setæ only, funicle four-jointed, joint four scarsely broader than the second.

Pronotum subopaque, slightly broader than long (20.5:18.5), widest near the base, posterior line distinctly produced medially, posterolateral angles slightly rounded, rather uniformly rounded at the sides, constricted before the middle, anterior margin narrowly rounded; summit behind the middle, anterior area steep and covered with remotely placed rather small asperities, anterior margin with fine asperities of nearly equal size, posterior area depressed and finely reticulate; side margins acute. Scutellum rectangular, subopaque.

Elytra wider and 1.40 times as long as the pronotum, sides subparallel on the anterior three-fifths, broadly rounded behind, declivity convex, striæ distinct but not impressed, strial punctures moderately large, rather shallow, not densely placed, interspaces finely reticulate, uniseriately finely punctured, from the punctures arise erect scalelike hairs which become more like true scales on the declivity.

Anterior tibiæ and tarsal segments with plumed appendages. The large series I have came from Mount Maquiling, Laguna Province, Luzon, and was collected by Mr. F. C. Hadden.

PLATYPUS CIRCULARIS Chappuis fem. nov.

Yellowish brown, head, pronotum, and declivity nearly black, 2.85 millimeters long, 4.3 times as long as wide.

Front flat, shining, very coarsely and rather sparsely punctured below, finer and denser above, vertex with the median line and another line laterad to that elevated and polished, remaining surface finely rugosely punctured.

Pronotum 1.6 times as long as wide, widest behind the lateral emargination, strongly shining, median sulcus fine, longer than the basal two-thirds of the pronotum, with a narrow deep patch of punctures of uniform size around the sulcus; remaining surface sparsely but rather coarsely punctured, a space laterad of the sulcus nearly devoid of punctures, the punctures more crowded near the base.

Elytra 1.7 times as long as the pronotum, as wide at the base and distinctly wider than the pronotum before the truncated apex; striæ punctate, sutural striæ and the eighth deeply, others not at all impressed, interspaces flat subimpunctate, base of the

third with a few obscure punctures; on the apical fourth the strial punctures at first coarse, densely placed, striæ impressed and interstices convex, then becoming more and more densely punctate; the apex perpendicular, finely rugosely punctured, with two shallow emarginations forming two blunt prolongations at each side similar to those in the male. Pubescence on the slope and truncation short and sparse.

Allotype.—Female, Mount Maquiling, Laguna Province, Luzon, April 11, 1931 (*F. C. Hadden*), from a log of balobo, *Diplodiscus paniculatus* Turcz.

TWO INTERESTING SHELLS FROM THE PHILIPPINE ISLANDS

By IDA S. OLDROYD

Curator of the Geological Museum, Leland Stanford Junior University California

ONE PLATE

The two species of shells described below were from the collection of the late Mrs. S. A. Mitchell, who was a resident of Manila for many years and who had a large collection of Philippine shells from various parts of the Archipelago. A portion of this collection was donated to Leland Stanford Junior University by her daughter, Mrs. S. L. Burkholder, of Manila. In working over this collection to send the duplicates to the Bureau of Science, Manila, in accordance with the request of Mrs. Burkholder, I came across many interesting shells:

ACMAEA STRIATA MITCHELLI subsp. nov. Plate 1, figs. 1 to 4.

Shell orbicular, striated, black and white on the outside and blue-white on the interior, with a central brownish spot, which in some specimens is dark, in others very light. The margin is black except at the places where the white wedge-shaped color patches, which number two or four, run from the interior central spot to the margin; on the exterior the white color wedges approach the apex more closely. Length, 28 millimeters; breadth, 25.

Type.—No. 16369, Bureau of Science, collected by Mrs. S. A. Mitchell.

Paratypes.—Conchological collection, Leland Stanford Junior University.

Type locality.—Southern Luzon, Philippine Islands.

This subspecies differs from *Acmaea striata* in having the white wedge-shaped color bands.

NERITA MITCHELLI sp. nov. Plate 1, figs. 5 to 7.

Shell thick, with fifteen to eighteen fine spiral riblets, the interstices of equal width. Exterior dirty white, banded with dull rose; in some cases the color nearly covers the shell while in

others only part of the body whorl is rose. Aperture porcellaneous and polished, outer lip thickened with faint dentations within. Columellar lip with from three to four dentations, the type having three; the columellar area with fine ridges covering the entire area and highly polished.

Type.—No. 16368, Bureau of Science, collected by Mrs. S. A. Mitchell.

Paratype.—Conchological collection, Leland Stanford Junior University.

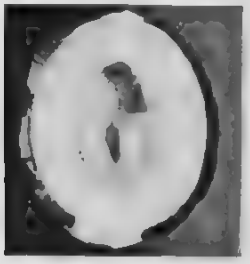
Locality.—Philippine Islands, no definite locality label.

This species belongs to the *Nerita polita* group, and differs from that species in that the spire is much higher and the sutures deeper. It is named for the collector, Mrs. S. A. Mitchell.

ILLUSTRATION

PLATE 1

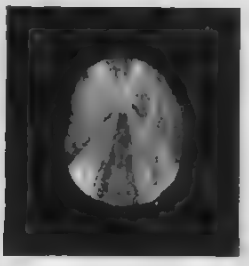
FIGS. 1 to 4. *Acmaea striata mitchelli* subsp. nov.
5 to 7. *Nerita mitchelli* sp. nov.



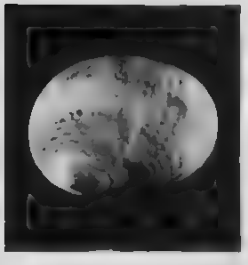
1

2

3



4



5

6

7

PLATE 1.

THE COMPOSITION OF SOME PHILIPPINE SOFT WOODS, V [1]

By AUGUSTUS P. WEST, F. M. YENKO, and LUZ BAENS

Of the Bureau of Science, Manila

and

H. M. CURRAN

Of the Bureau of Forestry, Manila

FIVE PLATES

The composition of woods is a matter of considerable importance for industries which use wood as their basic raw material. This paper is a continuation of our work on the composition of Philippine woods. Four papers have already appeared [2] and this one makes our fifth report.

An account of the general properties of some of these woods is given by Schneider.[3] Data on the woods which are not recorded by Schneider have been furnished us by Mr. M. D. Sulit, of the Bureau of Forestry. Brief descriptions are as follows:

Anabiong [*Trema orientalis* (Linn.) Blume] is a medium-sized tree reaching a diameter of 30 to 40 centimeters. The trunk (bole) is generally crooked and short, but when the tree is in a thick pure stand the trunk is straight. The bark is smooth and thick. The presence of lichens gives the bark a rather white appearance. The bark contains a watery liquid which has a color ranging from brown to blue and, when cut, stains the bolo. The crown of the tree is wide and spreading.

Anabiong is found throughout the Philippines at low and medium altitudes. It is characteristic of deserted clearings and second-growth vegetation where it occurs abundantly in pure stands. In Batangas Province the bark is used for dyeing

[1] This work is carried on coöperatively by the division of chemical research, Bureau of Science, and the Bureau of Forestry.

[2] Yenko, F. M., Luz Baens, A. P. West, and H. M. Curran, Philip. Journ. Sci. 47 (1932) 281 and 343; 48 (1932) 299; 49 (1932) 587.

[3] Bull. P. I. Bur. Forestry 14 (1916).

clothes and fish nets. The leaves are used for fodder and are gathered extensively during the dry season. The wood of anabiong is soft.

Fire (flame) tree [*Delonix regia* (Boj.) Saf.] is a medium-sized tree which is planted considerably in the Islands. The trunk is irregular and buttressed low. The diameter usually ranges from 30 to 40 centimeters. Trees planted in the open on good soil reach much larger diameters. The fire tree has a low, wide-spreading crown. It is deciduous (not evergreen) and has an average height of 12 to 15 meters. The showy scarlet flowers usually appear before the leaves. When in bloom this species is, perhaps, the most beautiful tree in the Islands.

The wood is soft in young trees and suitable for wooden shoes. It is not durable in the ground and is readily destroyed by termites.

Palong-manok [*Alangium chinense* (Lour.) Rehder] is a small to medium-sized, deciduous tree which is common in second-growth forests. The young tree has a smooth round trunk with a rather white bark. Palong-manok grows to a height of 15 meters, and the diameter ranges from 20 to 30 centimeters. The wood is not durable and of little commercial value. The sapwood is light colored and the heartwood dark. This tree is usually found from Ilocos Norte to Rizal, Laguna, and Batangas Provinces in primary and secondary forests at low altitudes.

Balsa (*Ochroma lagopus* Schwartz) is an upright branching tree which sometimes attains a diameter of about 60 centimeters and a height of about 18 to 21 meters. This tree has an open crown and a rather white bark.

In the Philippines there are promising prospects for the growing of balsa wood as a plantation crop. It is one of the lightest and fastest growing trees in the world. Trees planted in the Bureau of Forestry plantation at Los Baños showed after eight years an average yearly growth of about 4.5 centimeters in diameter and 2.2 meters in height. The young and fast-growing trees have the lightest wood. The maximum height may be attained in about ten years, but at this age the wood is of little value as it is not so porous and light. The wood near the pith, or center, is lighter than that near the bark. Although it is strong for its weight balsa wood crushes easily. If exposed, it is likely to be discolored, or attacked by borers and decay.

The balsa tree is propagated easily by seed and begins to bear fruit after three or four years. The pods contain fine fibers

which have a silky appearance. These fibers in which the seeds are embedded have no value for textile purposes but are useful for making mattresses, pillows, and cushions.

Balsa wood is useful for various purposes. On account of its lightness and buoyancy it is especially suitable for use in the manufacture of rafts, life boats, life preservers, and aëroplanes. It has been employed in the manufacture of insulation products and refrigerators. As it has natural acoustic or tonal properties it has been found to be satisfactory for use in the manufacture of radio loud speakers.

Ilang-ilang [*Canangium odoratum* (Lam.) Baill.] is a medium-sized tree which may reach a diameter of 50 to 60 centimeters. The trunk, which is sometimes fluted, is usually straight and characterized by a light gray color. The bark is thick and fibrous. Ilang-ilang is cultivated throughout the Islands. It is also found in primary and second-growth forests at low and medium altitudes.

Ilang-ilang oil is obtained by steam-distilling the flowers of this species. This essential oil, in perfume literature, is sometimes called the "flower of flowers." It is used considerably in the perfumery industry in the preparation of high-grade perfumes, such as lily of the valley and corylopsis. The manufacture of ilang-ilang oil is practically the only perfume industry in the Philippines.[4]

A good description of the distillation of ilang-ilang oil is given by Bacon [5] who worked out the process.

Alim [*Melanolepis multiglandulosa* (Reinw.) Reichb. f. and Zoll.] is a small to medium-sized tree which has an average diameter of 20 to 30 centimeters. It is seldom found in the forest but usually in open and abandoned places. This tree has a straight, short trunk with an open crown. The bark is finely ridged and has a color which varies from white to yellow. Alim is found throughout the Islands at low and medium altitudes.

Aleurites.—Two species of the genus *Aleurites* are found in the Philippines—*Aleurites trisperma* (baguilumbang) and *Aleurites moluccana* (lumbang). The wood of these species is practically identical. It is light, soft, and has a rather white color. The grain is straight, the texture rather coarse, and the durability poor. There is no distinct difference between

[4] West, A. P., and W. H. Brown, Philip. Bur. Forestry, Bull. 20 (1920).

[5] Philip. Journ. Sci. § A 3 (1908) 65; § A 4 (1909) 127; § A 5 (1910) 265.

the sapwood and heartwood. The wood is used for making matches, wooden shoes, and floats for fish nets.

Baguilumbang (*Aleurites trisperma* Blanco) is a medium-sized forest tree which reaches a diameter of 15 to 20 centimeters or more. The trunk is straight, cylindrical, and without a prominent buttress. The bark varies in color from brown to rather white and has a creamy appearance when cut.

Baguilumbang grows in forests at low and medium altitudes from northern Luzon to Mindanao. It seems to grow best near river banks or in valleys where it is protected from strong winds or typhoons. Baguilumbang oil obtained from the seeds of this species is not edible or suitable for use as a drying oil.

Lumbang (*Aleurites moluccana* Willd.) is a tree which grows to a diameter of 150 centimeters with a short but regular bole. It is distributed from Luzon to Mindanao and Palawan. The wood is practically identical with that of baguilumbang and is suitable for the same purposes for which baguilumbang is used.

The Hawaiians used to string the seeds of the lumbang tree on sticks and use them as candles to light their houses. The name "candle nut" originated from this use of the lumbang nuts and hence this tree was called the candle-nut tree.

Philippine lumbang (candle-nut) oil is obtained from the seeds of *Aleurites moluccana*. Lumbang oil is a drying oil which is used in making paints, varnishes, and similar products.[6] It has a composition similar to linseed oil and consists principally of the glycerides of linolenic, linolic, and oleic acids.[7] Philippine lumbang oil and the compounds contained in it have been investigated extensively.[8]

[6] West, A. P., and W. H. Brown, Bull. P. I. Bur. Forestry 20 (1920) 121.

West, A. P., and F. L. Smith, Bull. P. I. Bur. Forestry 24 (1923).

[7] West, A. P., and Z. Montes, Philip. Journ. Sci. 18 (1921) 619.

Cruz, A. O., and A. P. West, Philip. Journ. Sci. 42 (1930) 251.

[8] West, A. P., and L. Gonzaga, Philip. Journ. Sci. 23 (1923) 277.

West, A. P. and A. I. de Leon, Philip. Journ. Sci. 24 (1924) 123.

Imperial, G. A., and A. P. West, Philip. Journ. Sci. 31 (1926) 441.

Santiago, S., and A. P. West, Philip. Journ. Sci. 32 (1927) 41.

Smith, F. L., and A. P. West, Philip. Journ. Sci. 32 (1927) 297.

Oreta, A. T., and A. P. West, Philip. Journ. Sci. 33 (1927) 169.

Almoradie, P. R., and A. P. West, Philip. Journ. Sci. 33 (1927) 257.

Jovellanos, C. M., and A. P. West, Philip. Journ. Sci. 33 (1927) 349.

Santos, I., and A. P. West, Philip. Journ. Sci. 34 (1927) 199.

Vicente, M. L. A., and A. P. West, Philip. Journ. Sci. 36 (1928) 73.

Malapapaya [*Polyscias nodosa* (Blm.) Seem.] is a medium-sized tree which reaches a diameter of 40 to 50 centimeters. It is conspicuous for its characteristic growth habit. The trunk is straight with considerable tapering, and the tree, even when mature, has very few branches. The bark is rather white with prominent leaf scars. The wood is soft and light and the color varies from white to cream.

This species is found throughout the Islands at low and medium altitudes in second-growth forests and abandoned clearings.

Rain tree [*Samanea saman* (Jacq.) Merr.] is a large tree which may attain a diameter of 100 centimeters or more and a height of 20 to 25 meters. The bark is ridged and the branches wide-spreading and drooping. The wood, like akle, is suitable for making furniture but is seldom used. This species is commonly cultivated as a shade tree in towns located at a low altitude.

Basikong (*Ficus conora* King) is a small to medium-sized forest tree which reaches a diameter of 20 to 30 centimeters. The trunk is usually crooked and short. This species is characterized by tubercles (about 30 to 50 centimeters long) which are found on the branches and where the fruits (figs) grow. The bark has a dark-gray color with white spots which are caused by lichens. The wood is soft to medium with a white or gray color. This species has a wide-spreading and dense crown and grows at low and medium altitudes.

Tibig [*Ficus nota* (Blanco) Merr.] is a medium-sized tree which reaches a diameter of 20 to 30 centimeters. The trunk, which is short and generally crooked, is characterized by cauliflower tubercles. This species has an open crown and few branches. It grows throughout the Islands in thickets and forests at low medium altitudes and is very common along creeks. The wood is light and soft and has a white or gray color.

Binuñga [*Macaranga tanarius* (Linn.) Muell.-Arg.] is a small to medium-sized tree which is characteristic of deserted clearings and parang vegetation. The trunk is short and crooked and usually attains a diameter of 15 to 25 centimeters. This tree has an open and spreading crown. The bark is rather white but appears red when cut. The wood is light, soft, and white. This species is found throughout the Islands at low and medium altitudes.

Gubas (*Endospermum peltatum* Merr.) is a large forest tree which attains a diameter of 70 to 80 centimeters. The trunk is straight and without a prominent buttress. The color of the bark ranges from white to yellow and, when cut, the inner bark has a golden yellow color and a disagreeable odor. The wood is soft and pale yellow. This species is found throughout the Islands in primary forests at low altitudes.

TABLE 1.—*Measurements of Philippine trees used for wood analysis.*

Name of tree.	Diameter.	Total height.	Clear length of trunk.	Height from which specimen was taken.	Specific gravity of wood.[a]
	cm.	*m.*	*m.*	*m.*	
Anabiong; *Trema orientalis*	20	10.5	5.35	2.5	0.407
Fire tree; *Delonix regia*	16.5	17.0	5.3	3.10	0.411
Palong-manok; *Alangium chinense*	24.4	15.0	11.6	0.9	0.682
Balsa; *Ochroma lagopus*	17.6	12.0	5.05	3.6	0.138
Ilang-ilang; *Canangium odoratum*	21.0	13.4	11.0	0.7	----------
Alim; *Melanolepis multiglandulosa*	14.8	13.6	6.4	1.65	0.413
Baguilumbang; *Aleurites trisperma*	21.7	7.9	6.7	0.25	0.408
Lumbang; *Aleurites moluccana*	17.0	14.6	8.2	2.9	0.366
Malapapaya; *Polyscias nodosa*	19.1	12.8	12.0	0.60	0.496
Rain tree; *Samanea saman*	24.8	16.5	4.8	4.8	0.559
Basikong; *Ficus conora*	29.0	9.0	3.5	0.50	0.560
Tibig; *Ficus nota*	26.0	9.0	4.2	0.45	0.518
Binuñga; *Macaranga tanarius*	10.6	11.6	5.0	1.3	0.456
Gubas; *Endospermum peltatum*	17.3	12.0	7.0	1.4	0.456

[a] Figures for specific gravity are only approximate as the wood of some trees varies considerably.

In Table 1 are given the measurements of the trees from which samples were taken for our analyses.

In analyzing the wood samples we followed, in general, the methods adopted by the forest products laboratory at Madison, Wisconsin.[9] Certain details,[10] which we had found by previous experience to increase the accuracy of the results, were introduced in the analytical procedures.

[9] Bray, M. W., Paper Trade Journ. 87 No. 25 (1928) 59.
Schorger, A. W., Chemistry of Cellulose and Wood (1926) 505.

[10] Yenko, F. M., Luz Baens, A. P. West, and H. M. Curran, Philip. Journ. Sci. 47 (1932) 343.

RESULTS

The results obtained by analyzing the woods recorded in this paper are given in Table 2.

TABLE 2.—*Analysis of Philippine softwoods.*

Constituent.	Anabiong: *Trema orientalis.*	Fire tree: *Delonix regia.*	Palong-manok: *Alangium chinense.*	Balsa: *Ochroma lagopus.*	Ilang-ilang: *Canangium odoratum.*	Alim: *Melanolæis multiglandulosa.*	Bagtilumbang: *Alcurites triperma.*
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent*	*Per cent.*	*Per cent.*
Cold-water soluble	3.43	4.55	7.50	1.99	4.66	6.50	3.33
Hot-water soluble	6.63	8.37	13.39	3.99	10.18	12.82	6.49
Alkali soluble	20.56	17.25	23.00	21.62	15.97	25.30	22.39
Ether extract	0.44	0.22	0.84	1.16	0.97	0.45	0.56
Alcohol extract	4.43	3.60	10.25	2.74	3.38	2.09	2.42
Ash	1.16	1.77	0.84	0.85	2.51	1.32	1.74
Nitrogen	0.35	0.28	0.37	0.49	0.43	0.44	0.35
Lignin	28.72	24.65	29.33	28.83	23.38	29.07	31.71
Cellulose	55.02	58.66	51.47	54.68	45.91	50.97	51.10
Ash in cellulose determined	0.31	0.30	0.26	0.47	0.33	0.39	0.57
Cellulose ash free	54.71	58.36	51.21	54.21	45.58	50.58	50.53
Alpha cellulose in total cellulose	75.36	78.12	81.00	74.05	80.28	75.23	74.00
Alpha cellulose in the wood	41.46	45.83	41.69	40.49	36.86	38.34	37.81

Constituent.	Lumbang: *Aleurites moluccana.*	Mala papaya: *Polyscias nodosa.*	Rain tree: *Samanea saman.*	Basikong: *Ficus conora.*	Tibig: *Ficus nota.*	Binuñga: *Macaranga tanarius.*	Gubas: *Endosperman peltatum.*
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Cold-water soluble	5.05	2.60	3.47	4.84	5.48	3.39	2.69
Hot-water soluble	9.64	10.20	8.86	8.84	8.36	6.27	7.84
Alkali soluble	21.26	24.72	19.89	17.66	18.39	14.66	17.86
Ether extract	0.06	0.88	0.87	0.13	0.54	0.22	0.44
Alcohol extract	1.48	5.08	5.34	2.92	3.23	2.60	3.14
Ash	2.14	0.90	0.27	2.63	3.95	0.93	0.79
Nitrogen	0.36	0.30	0.58	0.34	0.49	0.40	0.40
Lignin	20.13	30.30	30.44	33.86	33.67	32.06	30.83
Cellulose	59.59	49.53	50.89	47.28	45.17	50.02	54.64
Ash in cellulose determined	0.97	0.42	0.41	0.18	0.63	0.38	0.27
Cellulose ash free	58.62	49.11	50.48	47.10	44.54	49.64	54.37
Alpha cellulose in total cellulose	77.93	73.33	75.35	73.62	73.49	79.51	80.96
Alpha cellulose in the wood	46.44	36.32	38.35	34.81	33.20	39.77	44.24

SUMMARY

Fourteen samples of wood from Philippine softwood trees were analyzed in this investigation. These woods have the common names anabiong, fire tree, palong-manok, balsa, ilang-ilang, alim, baguilumbang, lumbang, malapapaya, rain tree, basikong, tibig, binuñga, and gubas.

As shown by the data (Table 2) the lumbang wood has the highest content of cellulose and alpha cellulose but the lowest lignin content. Basikong has the highest lignin content. Tibig has the highest ash but the lowest cellulose and alpha cellulose content. The rain tree has the lowest ash content.

ILLUSTRATIONS

PLATE 1

FIG. 1. Fire tree; *Delonix regia* (Boj.) Raf.
2. Anabiong; *Trema orientalis* (Linn.) Blume.

PLATE 2

FIG. 1. Palong-manok; *Alangium chinense* (Lour.) Rehder.
2. Balsa; *Ochroma lagopus* Schwartz.
3. Ilang-ilang; *Canangium odoratum* (Lam.) Baill.

PLATE 3

FIG. 1. Alim; *Melanolepis multiglandulosa* (Reinw.) Reichb. f. and Zoll.
2. Baguilumbang; *Aleurites trisperma* Blanco.
3. Lumbang; *Aleurites moluccana* Willd.

PLATE 4

FIG. 1. Malapapaya; *Polyscias nodosa* (Blm.) Seem.
2. Rain tree; *Samanea saman* (Jacq.) Merr.
3. Basikong; *Ficus conora* King.

PLATE 5

FIG. 1. Tibig; *Ficus nota* (Blco.) Merr.
2. Binuñga; *Macaranga tanarius* (Linn.) Muell.-Arg.
3. Gubas; *Endospermum peltatum* Merr.

1

2

PLATE 1.

PLATE 2.

PLATE 3.

PLATE 4.

PLATE 5.